

**CHALLENGES IN TEACHING NATURAL SCIENCES IN THE CONTEXT OF NATIONAL
CURRICULUM STATEMENT CONTEXT**

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I declare that **CHALLENGES IN TEACHING NATURAL SCIENCES IN THE
CONTEXT OF NATIONAL CURRICULUM STATEMENT CONTEXT** is my
own work and that all the sources that I have used or quoted have been indicated and
acknowledged by means of complete references.



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24/02/2014

DATE

For Simon Tlamama, Jackson Swartland Mthimunye, Martha Sithando Myeni, Joseph Mtlerane Mnguni, Duncan Dumisani Mthethwa and Elias Soso (Mola) Mnguni called to rest. May their soul rest in peace.

To my family, friends, mentors, principals, colleagues and supervisors of this study, whose deep emotional identification gave me the strength to bring this study to a successful completion, I say:

May God bless you

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ABSTRACT

The study focuses on challenges in the development of learner-centred and process-oriented teaching and learning in the learning areas, natural science (NS) and mathematics in South African schools. The aim of NS is to develop scientifically literate learners. The three Learning Outcomes (LOs) and the accompanying Assessment Standards (ASs) should enable learners to understand the science products or system of ideas such as underlying theories and principles. The LOs point out the learner's abilities to use the sciences products or system of ideas. Educators encounter challenges in the application of the LOs and ASs in teaching and learning activities. Against this background, a mixed method study was conducted in selected schools in the Tshwane South District in Gauteng. Data were gathered by document analysis, focus groups and a questionnaire to gauge how the educators are applying the LOs and ASs. Findings indicated that lessons plans were inadequate and educators were not familiar with curriculum documents.

KEY TERMS:

Assessment standards, critical outcomes, developmental outcomes, integration, learning and teaching support material, learning outcomes, learning area, NCS/CAPS underpinning principles, core knowledge, concepts and unifying statements.

ABBREVIATIONS

| | |
|--------|--|
| ASs | Assessment standards |
| CAPS | Curriculum and Assessment Policy Statement |
| COs | Critical outcomes |
| C25 | Curriculum 2005 |
| DOs | Developmental outcome |
| FET | Further education and training |
| GDoE | Gauteng Department of Education |
| GET | General education and training |
| GETC | Gauteng Education and Training Council |
| GICD | Gauteng Institute for Educational Development |
| IDPMEC | Investigating, designing, planning, making, evaluating and communicating |
| IEB | Independent examination board |
| IKS | Indigenous knowledge system |
| IQMS | Integrated quality management system |
| LA | Learning area |
| LOs | Learning outcomes |
| LTSMs | Learning and teaching support materials |
| NCS | National Curriculum Statements |
| NS | Natural Sciences |
| OBE | Outcomes-based education |
| RNCS | Revised National Curriculum Statements |
| SBST | School base support team |
| SKAVs | Skills knowledge attitude and values |
| STS | Science-technology-society |

TIMSS Third International Mathematics and Science Study
WP6 White Paper 6

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CHAPTER ONE

ORIENTATION, PROBLEM FORMULATION AND AIMS OF THE STUDY

1.1 INTRODUCTION

After 1994, the new constitution of South Africa paved the way for much needed curriculum development at school level (DoE, 2002c:1). The aim of the constitution formulated in the period following the democratic elections and negotiations is to rectify the past by means of equity and redress (DoE, 2003a:1). Subsequently, a single Department of Education (DoE) was introduced and the country was divided into nine provinces in which the DoE introduced outcomes-based education (OBE). After launching OBE, in 1997 the DoE introduced a new curriculum for schooling known as Curriculum 2005 (C2005). C2005 was later revised, after which it was called the National Curriculum Statement (NCS). Subsequently, the Department of Education was split into the Department of Basic Education (DBE) and the Department of Higher Education. The DBE is currently in the process of introducing a new curriculum and assessment policy statement (CAPS) (DBE, 2011b:39). The basic principles underpinning C2005 were retained in the NCS and CAPS (DBE, 2011:6-7; DoE, 2003a:1-4).

The NCS requires significant changes in teaching and learning activities. It is important to note that the educator's role should be that of a resource person and mentor (DoE, 2003a:5). In this regard, the educators should teach learners ways of developing or generating new skills, knowledge, attitudes and values (SKAVs). Educators are no longer regarded as the sole gatekeepers of information. Importantly, educators should teach and design activities to enable learners to demonstrate and apply certain important SKAVs in their daily lives (DBE, 2011:5; DoE, 2002c:6-7; Van der Horst & McDonald, 2001:12-15). By integrating the SKAVs in teaching and learning activities, the result should be learners who are capable of exhibiting critical thinking and problem-solving skills in their communities and as citizens. The SKAVs are incorporated in the learning outcomes (LOs) and the assessment standards

(ASs). In the newly defined CAPS the LOs and ASs are combined as specific aims (DBE, 2011:23).

Educators were introduced to this system of education (based on the LOs and ASs) over a period of five days in development training sessions and workshops. Some educators complained that the period of development was too short and the core content knowledge of the learning areas (LAs) had not been dealt with adequately (GETC, 1999:51-56; Kgobe, 2003:81). The Review Committees on C2005 and the NCS also found that the training and development efforts were not sufficient to prepare the educators to facilitate the new curriculum adequately (Pretorius, 2008). The situation was complicated even further by the inter-relatedness of the different aspects embodied in the new curriculum. In the NCS, for each LA there are particular SKAVs associated with that LA which are embodied in the learning outcomes (LOs). In addition, these LAs must be interpreted and implemented against the background of the critical outcomes (COs) and the developmental outcomes (DOs), specified for the curriculum as a whole (DoE, 2003a:2).

The LOs that specify the SKAVs in a specific LA are described by the ASs (DoE, 2002:16-21). The DoE (2002c:15) states that, "The Assessment Standards are ways in which learners demonstrate the achievement of the Natural Sciences Learning Outcomes." Natural Science (NS) as one of the LAs (DoE, 2002:2) is concerned with the study of the material world around us that includes the human body, plants, animals and anything that occupies space (DoE, 2002:2; Driver, Squires, Rushworth, & Wood-Robinson, 1994:49). The LOs and ASs and the corresponding specific aims in the new curriculum and assessment policy statement are to be used to guide educators to design teaching and learning activities that are learner-centred and process-oriented.

1.2 BACKGROUND TO THE PROBLEM

The National Curriculum Statement as well as the Curriculum and Assessment Policy Statements advocate learner-centred and process-oriented teaching (DBE, 2011:6; DoE, 2003c:18-53; DoE, 2002c:46). Educators should let learners participate fully in the learning process and describe or explain how they arrived at their solutions to problems or products (DBE, 2011:7&11, GICD, 2004: 5). In this way, learners will be active in their learning and

develop critical and problem-solving skills in an environment that allows for flexibility and interpretation in learning and teaching (DoE, 2002c:8-9). Obviously this is not a straightforward process and educators are expected to understand how the different aspects (such as the COs, DOs, LOs, ASs, core knowledge and concepts of NS and the specific aims) are linked together and they should be able to apply these aspects when developing the learning and assessment activities for their teaching and learning activities. Within the Natural Science (NS) learning area there are three learning outcomes, their accompanying assessment standards and prescribed core knowledge that should be used to develop teaching and learning activities.

During the teaching and learning activities learners should be learning that NS is a worthwhile human activity in contrast with the old perception that NS is just another unrelated subject consisting of facts that have to be regurgitated. Accordingly, this is in line with the perception that the NS is difficult because not all three LOs and their accompanying ASs are achieved neither is integration within NS and across the other LAs is achieved either. Educators teach the products of NS as they are presented in the learning and teaching support materials (LTSMs). In the process, they use outdated methods such as textbook teaching, instead of teaching learners based on the three LOs and the accompanying ASs of NS. Consequently, they should be guided by the core knowledge for learners to learn what they come across (DoE, 2002c:61-75). In addition, integration should take place within NS and across the other LAs using the LOs and ASs. The DoE in-service training, extending over a period of forty (40) hours, dealt with the introduction of OBE (policy documents given to educators), the NCS principles, learning programmes, work schedules and lesson plans (Kgobe, 2003:81-83).

The DoE should organise more workshops dealing with the structures of each LA, which include the LOs and their accompanying ASs. Motshegwa (DBE,2010) asserts that: “The 2009 teacher Development Summit acknowledge the gravity of the problem and served as an important catalyst for taking teacher in-service training in South Africa to a new level.” The DBE (2011:4-7) has amended the improved NCS as CAPS based

on the challenges for educators to use the specific aims in their teaching. Kgobe (2003:82) asserts that:

Educators' workshops need to be conducted not only by knowledgeable people about OBE, but by people who have tried and practised it. Their training should not only be confined to district/circuit offices, but also to the educators' classrooms. Facilitators must present lessons in educators' actual classrooms. In this way, educators will have an opportunity to observe the actual use of the OBE approach.

In addition, these workshops should focus on how the LAs interact with each other. Attention should also be paid to issues and challenges regarding LAs that can be integrated into and also overlap with other LAs. The training should show how easily integration can be achieved by making use of core knowledge and concepts of NS, appropriate and well-designed work schedules and lesson plans as based on the study NS or other learning areas. This would enable educators to facilitate learning and teaching activities based on the LOs and ASs. Furthermore, the principles underlying the NCS will be implemented and interpreted by placing greater emphasis on the learner, by promoting critical thinking, self-discovery, team learning and ensuring that individual learning and learning in perspectives take place. Importantly, educators will teach learners to apply the SKAVs in meaningful and appropriate ways.

1.3 STATEMENT OF THE PROBLEM

The NCS was introduced to educators by explaining the principles embodied in it as well as the learning programmes, work schedules and lesson plans that should be included (DoE, 2003b). Facilitators at the workshops did not explain to educators how to use the LOs and their accompanying ASs in the above entities (learning programmes, work schedules and lesson plans) based on the teaching and learning activities for learners (Qwase 2007, cited by Mqwebu, 2009). According to the DBE (2011a:4), the challenges in the interpretation and implementation of the LOs and ASs lie in the teaching and learning activities. The NS LA includes the core knowledge and concepts of NS to allow for own local circumstances and broader contexts like the economic and environmental context (DoE, 2002:61).

However, educators still struggle to design activities based on the LOs and ASs. The DBE (2011:4-5) asserts that educators encounter difficulties when using the LOs and ASs for learning and teaching activities, particularly with regard to the improved and comprehensive CAPS that provides what to teach and learn (content from the four themes of NS) for each term in the school.

The LOs and the accompanying ASs describe and embody the SKAVs in the LAs (DoE, 2003a:7). The focus of this study is the LAs LOs and ASs (especially NS 3LOs and ASs and other LAs for integration purposes) not the specific aims of CAPS. This study attempts to determine how educators use the 3LOs and the accompanying ASs of NS and to what extent integration within and across the LAs takes place in their particular schools. As a number of educators appear to be teaching NS as a set of facts or a catalogue of answers from the LTSMs (Reddy, 2001:4), it is imperative that they should start teaching and learning of NS as a process or a dialogue with the material world. If the above teaching method is applied, it could enable learners to learn about and become familiar with scientific discoveries. Consequently, this can lead to their understanding of the material world as well as their place in this material world. The implementation of NS in grades 4 to 9 has not been interpreted and implemented correctly. Educators are still struggling with the use of the 3LOs and the accompanying ASs of NS and integration within NS and across the LAs. Further, some educators do not use all three the LOs and the accompanying ASs of NS in their teaching. Therefore, this type of teaching is not learner-centred or process-oriented.

1.4 RESEARCH QUESTIONS

Based on the above problem, this study addresses the following main questions:

- Are educators designing teaching and learning activities with reference to the 3LOs and the accompanying ASs of NS?
- Are educators integrating within NS and across the other LAs LOs and the accompanying ASs in their teaching and learning activities?

The following questions have also been formulated to clarify the main questions:

- Are educators using the process skills of NS to design teaching and learning activities (LO1 of NS and accompanying ASs)?
- Are educators relating scientific knowledge to the material world during their teaching and learning activities (LO2 of NS and accompanying ASs)?
- How are educators teaching learners to realise that NS is a human activity and how do they present the different world-views in their teaching and learning activities (LO3 and accompanying ASs)?
- Do educators integrate the LOs and the accompanying ASs within NS and across other LAs, LOs and the accompanying ASs in their teaching and learning activities?

1.5. AIMS OF THE STUDY

The overall aim of the study is to investigate and report on the achievement of the LOs and the ASs by NS educators in grades 7 to 9 and to determine if they are using the three LOs and the accompanying ASs of NS and are integrating the LOs and the accompanying ASs across the LAs in their preparation and teaching. This aim is pursued by means of an empirical inquiry into the teaching of the NS LA at selected schools in the Tshwane South District. To achieve the above aims, the study uses an appropriate research design and applicable methods to investigate the situation (Creswell & Plano Clark, 2007:5). This is aimed at improving the achievement of South African learners in the Third International Mathematics and Science Study (TIMSS) and increasing the ranking of South African learners who currently occupy the 38th position in the world (Howie, 2002; Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009). A further aim is the development of scarce skills in NS. Another aim is to encourage more learners to become interested in the sciences. The final objective is to promote the use of integration for the enhancement of teaching in order to develop scientifically literate learners.

The sub-aims of this study are to:

- Investigate whether educators are developing teaching and learning activities using scientific investigation based on LO1 and the accompanying ASs of NS.
- Explore if educators develop teaching and learning activities that are based on the product or system of ideas from LO2 and the accompanying ASs of NS.
- Determine if educators are designing teaching and learning activities that demonstrate that NS is a human-activity which embodies different world-views from the three LOs and the accompanying ASs.
- Identify if educators develop activities and are using integration within NS (the LOs and their accompanying ASs) and across the other LAs (the LOs and their accompanying ASs) for enhancement of their teaching and learning activities.

1.6 RESEARCH DESIGN AND METHODOLOGY

In order to investigate the problem and address the research questions, data was gathered from NS educators teaching NS at selected schools in the Tshwane South District. An approval request form was completed and submitted to Tshwane South District (see attached Annexure 1 and 2) for approval by the Gauteng Provincial Department of Education (GDoE). The study aimed at obtaining clarity on what was happening in particular schools in the Tshwane South District in Gauteng Province. Four schools were selected from Mamelodi East of Pretoria respectively and another two independent schools in the Tshwane South District were also selected. The various data collection methods included a literature review, investigations of lesson plan, focus groups and a questionnaire. The literature review explored the NCS principles and the NS LA LOs and the ASs. The integration within and across NS LOs and the ASs and other LAs LOs and ASs and the NS LA 3LOs and the accompanying ASs were explored. Observations involving NS situations in the lesson planning were also conducted. The study of the lesson plans involved the use of data collection instruments to obtain the required information (application of the LOs and ASs) from the educators in terms of their planning as reflected in their the lesson plans. Furthermore, focus groups were used to determine the extent to which educators in particular schools understand the use of the LOs and ASs in their teaching and learning activities.

Lastly, a questionnaire was used to validate the study and to determine whether the intervention of the focus group had made a difference.

1.6.1 Research design

A mixed method research design using both qualitative and quantitative research approaches was employed (Creswell & Plano Clark, 2007:5; De Vos, 1998:359-361; Mouton, 1996:156-157). This research design provides clarity on and a greater understanding of the topic. The mixed methods approach in the study involved the study of the lesson plans, focus group discussions and a questionnaire (Creswell & Plano Clark, 2011:61; De Vos, 2011:434-448) to determine to what extent educators used the core knowledge and concepts of NS, NS LOs and ASs and applied integration within the NS LOs and ASs and across other LAs, LOs and ASs. In the focus groups educators provided information on what was happening in their particular schools regarding the use of the LOs and ASs. The questionnaires validated whether the intervention had an influence on the use of LOs and ASs. In addition, the questionnaires provided background information regarding aspects such as the demographics of the school and qualifications of educators teaching the NS LA in the particular school.

1.6.2 Research methods

The NS lesson plans were analysed in the particular schools for grade 9 only. GICD (2004:7) states “The General Education and Training Certificate for compulsory schooling is a whole qualification for schools based on the extent to which the learning outcomes will be achieved through the Grade 9 Assessment Standards.” In addition, focus groups were used to obtain relevant information from grade 7 to 9 NS educators in the selected schools about the use of the LOs and ASs for their teaching and learning activities in particular school. The questionnaire was used to investigate if they had learned anything from the focus group discussions that entailed enquiring about the use of the LOs and ASs.

1.6.2.1 Document analysis

The document analysis is a valid research strategy with considerable merit as a methodology to analyse educators' lesson plans from policy documents of the LAs for evaluation and reform. The DoE (2003b:61-63) gives clarity on the planning and the analysis of the lesson plan. The lesson plan content was analysed based on the use of the LOs and ASs in designing teaching and learning activities. The analysis of the lesson plan entailed being on site to investigate what was happening during the NS lesson teaching and learning activities. This meant investigating to see if the LA (NS) structure was used in practice as specified in the NCS. The lesson plan demonstrated if the LOs and ASs of NS were based on the topic or theme of NS. This indicated whether the teaching and learning activities occurring at these schools was process-oriented and learner-centred.

The educators were told that this research method would enable the researcher to view how NS was taught in the school. In addition, research ethics were observed, such as protecting the rights of the participants and not victimising them. A further point was that no classes were interrupted by the study. Lesson plan analysis enabled the researcher to obtain information on the challenges encountered in the planning specified by the NCS for the LAs (DoE, 2003b). Importantly, the lesson plan analysis content focussed on the three LOs and ASs of NS. In addition, the researcher analysed if integration was enhancing the teaching and learning activities of the theme or the topic based on the LOs and ASs.

During lesson plan analysis, an assessment checklist (consisting of one of two options, namely, either "Yes" or "No") was used to determine whether the LOs and the ASs of NS had been achieved and whether integration with other LAs had enhanced the learning and teaching in terms of the lesson plan (McMillan & Schumacher, 1997:261). The checklist was used to assist the researcher to determine whether the educators had interpreted and implemented the NS LOs and ASs and whether integration was taking place. In other words, it allowed the researcher to assess whether the educators had changed the traditional educational teaching methods used before 1994. This analysis was carried out in terms of the changes specified by the principles underpinning the NCS in the planning of teaching and learning activities (DoE, 2003a:7; DoE, 2003b). The questionnaire which followed the focus group sessions was used to determine if the latter had made a difference. The questionnaire

provided greater understanding of the topics discussed and supplemented the lesson plan observations and the focus group discussions.

1.6.2.2 Focus group discussions

Focus group discussions in the selected schools indicated how NS LOs and ASs and their integration were interpreted and implemented during classes. The researcher formulated questions beforehand to guide the focus group interview. Importantly, the research questions were used as headings. In addition, integration was also used as a heading. This helped to clarify the three LOs as well as the ASs of NS in the senior phase (grade 7 to 9 classes) and the teaching and learning activities in the selected schools.

1.6.2.3 Questionnaire

The questionnaire consists of two sections. Section A consisted of the biographical and demographic profile of the schools and educators. This reflected the conception of self (educator) and the school to be identified and the understanding and usage of the LOs and ASs for teaching and learning. Section B investigated the perceptions of the educators based on the LA NS LOs and ASs and the in-service training attended by the educators to use the LOs and ASs within and across for teaching and learning activities.

1.6.3 Literature study

Literature dealing with the NCS principles was studied as well as the principles underlying NCS that provided clarity on the COs and DOs. The key outcomes of the NCS are the COS and DOs that are inspired by the Constitution of South Africa (DoE, 2003a:2). The COs and DOs should be developed through the LAs such as NS and Technology (DoE, 2002c:15). In turn, the COs and DOs will be achieved through the LOs and ASs in the LAs. Accordingly, the NS LOs and ASs were the main focus in the study together with their integration with other LAs LOs and ASs for the design of the teaching and learning activities. The NS LOs and ASs were studied in detail, in terms of the research questions as well as in terms

of how their integration across and within the curriculum enhanced the teaching and learning in classrooms.

1.7 DIVISION OF THE STUDY

Chapter two contains a literature review covering various aspects regarding the topic of this study.

Chapter three describes the research design, methodology and instruments that were used in this study.

Chapter four concentrates on the data collection methods used in this study and analysis of the data collected. Findings regarding the lesson plan, the focus group and the questionnaire are presented and discussed in terms of the LOs and ASs respectively.

Chapter five provides an overview of this study by giving a summary of the main findings, the conclusions and recommendations.

1.8 SUMMARY

This chapter has sought to clarify the importance of redress and equity in education, which has paved the way for the OBE curriculum introduced as C2005 and which was later revised, modified and renamed the NCS, containing principles based on the Constitution of South Africa that encourages the acquisition of SKAVs. Importantly, the NCS has introduced certain learning areas (LAs) that are different fields of knowledge that entail the acquisition of certain SKAVs. To ensure that the SKAVs are attained, it is necessary to introduce the LOs and ASs informed by the COs and the DOs that have to be achieved in learning, teaching and planning. Further, the NCS allows for flexibility and interpretation by encouraging the integration of the LOs and ASs within and across the LAs that will lead to the enhancement of teaching. The above can be achieved through teaching perspectives (Rens, 2002:19-20) that will encourage learners to become interested in all the LAs.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter contains a survey of the literature regarding the challenges connected with teaching the natural science learning area (NS LA) in terms of the principles underlying NCS. LOs and ASs have been determined for all the LAs, as is also the case with NS and a great deal of emphasis is placed on integrating theory and practice. The NCS is different from the previous education system in that theory and practice were previously not integrated. This has created a situation where educators teach learners the NS products or systems of ideas that were the teaching and learning activities prior to the NCS. In terms of the NCS, educators should be able to teach learners to apply what they have learnt in the classroom to any situation (Erickson, 2008:45). Importantly, the LOs and ASs of NS support the tenets of the NCS, such as the fact that it is learner-centred and process-oriented (DoE, 2002:5; Spady & Schlebusch, 1999:29).

The aim of NS is to develop and guide learners so that they become problem solvers (DoE, 1997; 2002; & Howe & Jones, 1998). This is made possible by achieving the three learning outcomes (LOs) and the accompanying assessment standards (ASs) of NS and by integrating within and across the different LAs (Potgieter, 2008). Accordingly, the ASs of NS should be applied to the core knowledge and concepts with the aid of the unifying statements of NS for 30% and 70% of teaching and learning activities (DoE, 2002:61-75). The DoE (2002:61) explains that: “The unifying statement also provides a broad statement under which further content, which may be added in terms of the 30% time allocated to local options.” Spady and Schlebusch (1999:83) assert that the core knowledge and concepts of NS are based on a unifying statement in teaching by using learners’ immediate environment. Educators are to design activities that are based on the LOs and ASs in their teaching and learner activities.

2.2 THE INTRODUCTION OF THE OBE SYSTEM

The democratic elections paved the way for new developments in learning and teaching in SA schools. The principles that underpin the current education systems are informed by:

- The Constitution (Act No. 108 of 1996) of SA.
- The reconstruction and development programme (RDP) based on the Constitution's goals (RSA, 1996; ANC, 1994).
- Social development.
- Legislation and departmental policies such as those of the Department of Education (principles derived from the White Paper on Education and Training Policy Act No. 27 of 1996) and the Department of Health.

The principles that underpin the education system have led to the development of learning outcomes (LOs and ASs) that guide the development and education of learners and the society or the community (Spady & Schlebusch, 1999:29). They are aligned from the critical outcomes (COs) and developmental outcomes (DOs) (Spady & Schlebusch, 1999:61-62). The DoE based both the C2005 and later, the NCS on those outcomes, namely the DOs and the COs that inform and support the curriculum as a whole (DoE, 1997:12-13). They are so broad that they integrate the skills, knowledge, attitudes and values (SKAVs) that we expect of all South African learners or communities to enable them to make meaningful contributions to the material world (DoE, 1997).

The COs and DOs have led to the introduction of C2005. Policy makers and politicians pay too much attention and spend too much energy on educational change. The “why” part forms a large part of programmes that tend to focus on the adoption of the programmes and neglect the implementation of C2005. Educators are still waiting to be provided with more details around the implementation of CAPS (as of November 2011). This brought about a situation where C2005 was revised, after which it was named the NCS. Importantly, the NCS has a different philosophy to the apartheid education, which supported a teacher-centred approach and where the focus was on the examination of the syllabus. The NCS has introduced eight

LAs for grades 4-9 that are based on the COs and DOs. CAPS has brought changes in the LAs by changing them to subjects in the intermediate and the senior phase (grade 4-6 and grade 7-9) with clear content and a time frame for teaching and learning (DBE, 2011:9). In addition, the NCS introduced policy documents that contain many visionary and developmental educational ideas. However, to explain the “why”, policy makers and politicians postulate that achieving results in the implementation of the NCS is much slower and more difficult than it should be. Pretorius (2008:2) comments as follows:

One day in 1997, I asked the then education minister, Sibusiso Bengu, at a news conference about the rushed implementation. He suggested the hunger for change on the ground had to be fed, but also that this was the type of question was typical of what he termed “conservative forces”.

Musker (1997:3) points out: “We [the DoE] cannot afford - politically or economically - to delay the qualitative change that the education system needs. As the official put it, the whole nation has to be a pilot.” Nevertheless, the “why” part of the curriculum should have been addressed with the “how” part of the curriculum. The above should have been looked at with regard to what happened to C2005, namely, the rushed implementation. The two questions (“how” and “why”) will allow the NCS to be interpreted and implemented in terms of its vision and educationally sound ideas (Spady& Schlebusch.1999:54). This will mean that the COs and DOs linking the LAs with LOs and ASs will make teaching more relevant. Taylor (2008) asserts:

These devices – such as the critical and developmental outcomes, contextualisation, indigenous knowledge, human rights and so forth - are designed to make curriculum more relevant to the lives of learners, to make knowledge more accessible and to ensure that knowledge is used for developmental purpose rather than repression and domination.

The “why” part of C2005 and the NCS was addressed by the need for curriculum change. The “how” part will look at any theory connected with its implementation, such as the diversity of schools and educators’ qualifications. Therefore, the one size fits all approach should not be used in the workshops and training presented by the DoE (Umalusi, 2006:14).The principles underpinning NCS (DoE, 2003b:5-6) are based on the Constitution of SA (RSA, 1996), the RDP and legislation.

The principles underpinning the NCS allow for flexibility in teaching, learning and qualifications based on integrating the SKAVs (SER, 2009:7-9; Spady & Schlebusch, 1999:30). The principles underpinning the curriculum make it possible to assess learners in different ways (DoE, 2003b:16-17). In addition, the assessment process will be based on the core knowledge and concepts of NS (DoE, 2002:61-75); this is the learning area on which this study focuses. The NCS has proposed certain strategies to apply to teaching using the core knowledge and concepts of NS using the process skills of NS (DoE, 2002:16-17). Furthermore, these skills should be integrated creatively with everyday practice (based on the core knowledge and concepts of NS) (DoE, 2002; DoE, 2003:35). Importantly, the strategies are applicable in different situations and contexts based on the core knowledge and concepts of NS (DoE, 2002; DoE, 2004:5). Valanides (1996:99) points out:

The new curriculum and the corresponding teaching approaches are expected to enhance student-reasoning abilities. This expectation is in line with research studies related to interventions to accelerate students' cognitive development.

This will make the integration of theory and practice possible and is in line with what the NCS envisaged for the country. The NCS expects teaching and learning activities to integrate theory and practice, which implies that education should be linked to employment or work situations or work skills underpinning the principles of the NCS and the constitution. DBE (2011:6) asserts that:

This curriculum aims to ensure that children acquire and apply knowledge and skills that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives.

The National Qualifications Framework (NQF) is a set of principles and guidelines in terms of which communities or learner achievement is to be registered and credited. Importantly, the NQF also underpins the NCS principles (Spady & Schlebusch, 1999:55; Sparg & Winberg, 1999:26-47). The various levels show how practice and theory are integrated, based on the achievement of clearly defined learning outcomes (LOs). To assess whether the LOs are achievable, the assessment standards (ASs) are applied. In this regard, the NCS has

introduced LOs and ASs that are based on the DOs and COs which, in turn, are based on the principles that underpin the NCS.

2.3 THE NATIONAL CURRICULUM STATEMENT CONTEXT

The NCS was conceived along the key principles of our Constitution such as redress and equity. The COs and DOs that form the background of the NCS are broad and support the Constitution of the country (SA). The COs and DOs are aspects that can be achieved and understood through the LAs (Killen, 2010:395; Musker, 1997:13-14). In addition, the different LAs LOs and ASs must be used in teaching and learning activities; also integration (LOs and ASs) will enhance knowledge of the LAs. In this regard, the integration of SKAVs is applicable through the principles that underpin the NCS. Furthermore, the DoE has introduced various LAs LOs and ASs. Moreover, the South African Qualifications Authority (SAQA) has adopted the COs and DOs that focus on the ability to apply SKAVs (DoE, 2002b:2).

It is important to point out that SKAVs should be developed in teaching and real-life situations such as in the workplace. The SAQA adopted the DOs and COs with the introduction of the LOs and ASs in the LAs. In addition, the SAQA used the COs and DOs as a rationale for each LA. The LAs are the vehicles for achieving the COs and DOs as well as various SKAVs. Accordingly, the LAs are there to support development in teaching through the integration of LAs LOs and ASs. Integration in teaching will be possible in terms of cross-curricular processes, content, conceptual frameworks and cognitive development. In addition, the NCS promotes life-long learning processes and is learner-centred; focussing on what it is that learners are doing. Importantly, the processes and active learning will be visible through the SKAVs that should be the visible outcomes of the actual teaching and learning activities applying the LOs and ASs. The visibility of SKAVs can be achieved in an integrated way where learners apply the SKAVs they have acquired in school to the outside world or real-life situations (DBE, 2011:6; & Killen, 2010:68).

The LAs are different fields of knowledge that are included in the LAs. The underlying

rationale behind the LAs is the holistic development of learners in the form of holistic teaching and learning activities based on critical thinking and creative thinking. In this regard, the critical teaching and learning skills prescribed by the NCS require the teaching and learning activities based on the SKAVs. Importantly, creative and critical teaching employing hierarchies or perspectives would develop learners in a holistic way. It also needs to be noted that the process skills of NS (to be clarified later) are flexible enough to allow debate by including two worldviews (indigenous knowledge systems (IKSs), traditional knowledge systems and modern science and technology). In addition, creative and critical teaching should be flexible in terms of including the principles of the NCS, such as integration and applied competence (DoE, 2003). Evidence of the above will make it possible to place a learner in different phases or bands.

It is easy to assess whether the learner has acquired the SKAVs or part of them through outcomes-based assessment (OBA) (DoE, nd: 9-11). OBA makes it possible to place our learners in different phases or bands. A learner who is competent in the various SKAVs can be placed in a relevant institution that is concerned with the aspect in which he or she is competent. Accordingly, the learner can be placed in one of the different bands of the NQF. The DoE has made ten years of schooling compulsory (that is from grade R to grade 9 in terms of formal schooling). The above will allow for the integration of theory and practice and learners will receive the opportunity to become literate and numerate and to acquire both life skills and work skills. Importantly, the DoE has established colleges to provide support structures for the curriculum in terms of the SKAVs (DoE, 1997:9). Learners can register at this type of college to complete the NQF band and levels that support an N1 or a grade 10 course. The NQF sets out the principles and guidelines according to which learner performance is recognised in terms of the different OBA principles (DoE, nd: 9-11). The basic requirements regarding the required SKAVs to ensure integration and promoting lifelong learning are set out in the NQF whose focus is on changing the focus of the competencies in theory and practice (education and training) away from the emphasis on outcomes-based performance.

The DoE (1994:11) states that the aim of the NQF is to promote flexibility and use the NCS

to improve learning and teaching standards, to monitor and regulate the qualifications and to base the qualifications and credits on the principles that underpin the NCS. The DoE implemented the NQF to facilitate the movement of learners from one phase to another or from one grade to the next (Musker, 1997:7-8). In this regard, the NQF encourages flexible learning in formal and informal learning situations. The learning can take place in learning situations such as the workplace, self-study and community learning centres. Importantly, the NQF will enable all learning to be certified or eligible for certification (Spady & Schlebusch, 1999:120). The above approaches are necessary to enable South African learners to broaden their SKAVs and competencies in order to attain greater flexibility in the education and training system. Significantly, the NQF bases all credits or learning on the outcomes. The GET band and the FET band provide the foundation for integrating the SKAVs within which existing competencies and new qualifications can be recognised. In addition, the two bands will enable learners to undergo performance-based assessment, informed by the principles that underpin the NCS. The aim is to acquire qualifications or credits rather than to compete against other learners. The aim of the above qualifications or credits that are stipulated by the NQF is to make the achievement of the goals of the Constitution or the principles that underpin the NCS possible. The above goal can be achieved through the LOs and ASs and the integration of the LAs in teaching and learning activities. This will be based on what the NCS envisages, namely that our learners should become technologically and scientifically literate and become proficient in literacy and numeracy.

In addition, they must acquire certain basic life and work skills that will be visible in the three LAs in the foundation phase. The three LAs of the foundation phase are integrated within the intermediate and senior phases (grades 4 to 9) and the further education and training (FET) band (grades 10-12) (DoE, 1997:29). The former will include other LAs in the intermediate and senior phases that will entail a choice between FET and higher education (HED) qualifications. Importantly, the development of learners will necessitate the inclusion of personal and socio-economic aspects in the teaching and learning process that can make learners aware of the importance of values and attitudes in teaching. These developments should lead to achieving the DOs that will become apparent when learners can solve problems, make decisions, think critically and creatively and understand the material world.

This will assist in developing skills such as communicating and listening. The COs and DOs inform the LOs, which are descriptions of what should be known, what learners should be able to do and be like at the end of a grade or phase. These COs and DOs specify aspects such as processes and concepts (the SKAVs) in the LAs and focus on the conceptual enhancement and needs of learners that can be realised through the integration within and across LAs. The LOs are embodied in the ASs that describe the level at which the SKAVs are demonstrated in the achievement of LOs. The ASs are the vehicles used to achieve the LOs by learners.

Importantly, the ASs change from grade to grade or phase-to-phase (based on the principles that underpin the NCS, such as progression). Furthermore, LAs show progression in learning and teaching (DoE, 2003:70-73) and allow for great flexibility and integration in terms of the SKAVs. Killen (2010:68) defines progression of the ASs as:

The Assessment Standards in the Work Schedule for Grade10 will indicate the progress that learners should have made by the end of Grade 10 towards their achievement of the Learning Outcomes for the subject. In the Grade 11 Work Schedule, the Learning Outcomes do not change but the expected Assessment Standard is higher again.

ASs also provide guidelines for resources and activities (Potgieter, 2008). In addition, it is important to note that the LOs and ASs lead to the holistic development of learners. The above aspects are made possible by integrating the LOs and ASs of other LAs in the teaching situations. Importantly, integration with other LOs can make it possible to integrate the SKAVs that will help apply theory to practice, by turning knowledge into skills or academic knowledge into practical applications.

2.4 IMPLEMENTATION OF THE NCS IN SA

The implementation of the NCS was stressful as eighty hours were spent on workshops and training coupled with the introduction of policy documents that educators had to interpret and implement. In addition, there were implications in terms of time, money and effort for everyone concerned. What is more, the people who introduced this curriculum were

educators who had only received three weeks' training (Pretorius, 2008). Accordingly, this development process was accompanied by considerable tension because of pressure from politicians and the national government to speed up the process (Kgobe, 2003; Pretorius, 2008; Taylor, 2008). Furthermore, there was a regular turnover of curriculum designers and most of the committees lacked the necessary expertise for the design of the curriculum. In addition, successive DoE ministers, namely Ministers Sibusiso Bengu, Kader Asmal, Naledi Pandor and Angie Motshegwa respectively, introduced a number of changes to the curriculum.

There were different committees consisting of various sub-committees as stipulated by the independent examination board (IEB) submission in 2006. The IEB points out that those involved in the curriculum development structures had limited expertise in curriculum development. In addition, the designers changed from meeting to meeting and this turnover in personnel had a negative effect on the progression and smooth development of the curriculum. Some of the problems surrounding the personnel rendered it impossible to implement the overall vision and educationally sound ideas of the department. This brought about a situation that did not promote the principle of addressing the diversity in schools or educators' qualifications. Accordingly, Spady (2008:18) has identified certain major problems in connection with the interpretation and implementation of outcomes-based education (OBE).

In essence, developmental plans had failed to take educators' level of knowledge into account, which brought about problems with the interpretation and implementation of the new curriculum (the NCS), despite the fact that the DBE (2011:23) claims that educators are familiar with the LOs and ASs for teaching and learning activities. That is why independent schools fare better with the development of educators who are teaching in terms of the principles of the NCS. People in higher positions, such as educators employed by the government and those who can afford to do so, send their children to private or independent schools. All these people wanted a better standard of education for their children. Vijay cited by Mgwebu (2009) points out: "Seen side by side, the two [sets of] figures proved that the inequalities of the past persist because students from better resourced schools were better able

to adapt to the OBE programme.” This tendency to ignore diversity and to mandate complex and comprehensive changes in education has led to the inability of public schools to interpret and implement the NCS.

Qwase, cited by Mgwebu (2009), identifies the various challenges faced by educators: “The capacity of teachers to translate the policy and methodology to make an impact and succeed.” The application of the NCS policy and methodology hinges on the LOs and their ASs. Since the introduction of the new system of education, the performance of schools has deteriorated every year. Significantly, South African higher institutions are complaining about learner performance and the poor performance of learners in the international benchmark tests such as the TIMSS 1999-2003 (House, 2002; Mullis et al., 2009). In 2008, Minister Pandor, points out the challenges and the need for assistance in the teaching and learning in schools as “A call to all South Africans to join hands with the Department of Education to improve learning outcomes in these crucial areas” (DoE, 2008). Subsequently, the DoE has provided support to grade 12 learners by introducing a number of study guides in various media such as newspapers and television. However, the educators did not receive any extra support (Pretorius, 2008). At best, many educators use photocopied worksheets and get learners to paste pictures from books or magazines into their workbooks or onto worksheets. It is, therefore, not surprising that Spady, the self-proclaimed father of OBE, has remarked that South Africa should not call the new system OBE, as it did not adhere to the principles that underpin the NCS (Spady, 2008).

Currently, the DoE (DBE) is trying to align itself with higher institutions, by introducing certain courses and modules covering the NCS LAs. The aim of the courses is to intervene in the teaching of the NCS LAs. What the DoE is doing is in line with the changes suggested by (Treagust, Duit, & Fraser, 1996:132) who explain what this approach to teaching and learning entails:

It describes learning as a process in which a person changes his or her conceptions by capturing new conceptions, restructuring existing conceptions (i.e., a process of conceptual change).

Curriculum changes are good when they precede one-step at a time. This means that the NCS

should have been introduced in small incremental steps to allow educators to adapt their teaching to the new approach (NCS). Accordingly, C2005 should not have changed in its entirety; the DoE should have introduced it alongside the old system and the NCS. This would have allowed for the speeding up of changes in the curriculum. For example, if a school lacks educators without the proper grounding in the contents of a certain LA, then in-service training should begin by focussing on that aspect. In effect, the NCS should be developing in the same the way as concepts are in NS. Educators should use the three LOs and the accompanying ASs of NS and integrate them within NS and across the other LAs. Treagustet *al.*, (1996:133) suggest that the following questions should be of concern regarding the understanding of concepts:

A critical point is that it is the *learner* who has to decide, implicitly or explicitly, whether they are met. First, is the conception *intelligible to the learner*? That is, does the learner know what it means? Is the learner able to find a way of representing the conception? Second, is the conception plausible to the learner? That is, if a conception is intelligible to the learner does he or she also believe that it is true? Is it consistent with and reconcilable with other conceptions accepted by the learner? Third, is the conception *fruitful* to the learner? That is, if a conception intelligible to the learner does it achieve something of value for him or her? Does it solve otherwise insoluble problems? Does it suggest new possibilities, directions and ideas? The extent to which the conception meets these three conditions is termed the *status of a person's conceptions*.

The quality of teaching the learner receives is dependent on the ability of the educator to master and apply the principles set out in the NCS. Proficient educators will be able to use the NCS with the various LAs with the LOs and ASs and will be able to integrate the different LAs in terms of their LOs and ASs. Effective educators will use the NCS by interacting with it and by making it their own. Importantly, they should aim to adhere to the principles of OBE endorsed by the DoE (Barbeau, 2008).

2.4.1 Learning and teaching in terms of the NCS in the context of NS

“The NCS builds its learning outcomes for Grades 10 to 12 on the Critical and Developmental Outcomes that were inspired by the Constitution and developed through the democratic process” (DoE, 2003:2). The NCS states that the contexts for achieving the goals of the Constitution are through the LOs and ASs in teaching, assessment and learning. The goals of the Constitution are the improvement of the quality of life of all citizens and

development of the potential of each person and the building of a united democratic SA that is able to take its rightful place as a sovereign state in the family of nations. It is important to point out that NS should cater for all learners in the classroom situation, in terms of the principles that underpin the NCS. As the three LOs and the NS ASs are flexible, they can cater for the uniqueness of individual learning styles and also respect the diversity of learners and encourage them to integrate NS within and across other LAs. The LOs are clear and observable while the ASs contains action verbs indicating the aspects that need to be achieved. It is important to note that the DoE (2002:48-59) asserts that this approach is learner-centred and process-oriented. Furthermore, the NS LA consists of different themes or strands (DoE, 2003b:24) that are made possible by the core knowledge and concepts of NS (DoE, 2002:61-75; & DoE, 2003b:24 & 74-84). Learners learn about something that they know and can apply to aspects in the everyday life around them. This is possible when the teaching is based on the core knowledge and concepts of NS that make it easy for NS to be taught as a practical LA (DoE, 2002:61). In this way, provision is made for its integration into real life.

The GET band shows progression to the FET band through the ASs of NS. A theme such as *Matter and material* forms the basis for the LA or the subject Physical Science and *Life and living* is also based on the Life Sciences. The ASs of NS in the GET band provide clarity about what is to be learned and taught to learners. Accordingly, the ASs are to be applied to the core knowledge and concepts of NS (Jansen, 2010). The ASs indicate which learning standards learners should attain, achievement is evident when the learner, for example, is placed in a grade or phase. It is important to note that the NS LA employs holistic teaching and learning that achieve the three LOs and accompanying ASs of NS stating the SKAVs. Skills are associated with LO1 of NS, namely the NS process skills; while knowledge is associated with scientific knowledge (LO2) and attitudes and values are associated with learners realising that NS is a human activity that incorporates the two worldviews. The core knowledge and concepts of NS provide explanations for anything that occupies space and gives different explanations based on different world views (LO3 of NS) such as the traditional and indigenous knowledge systems (IKS) and modern science and technology (Collette & Chiappetta, 1994:30). LO3 of NS emphasises the impact of the

processes and knowledge on the environment, technology and societies. In this regard, the NS LA asserts that teaching should be based on the three LOs and the accompanying ASs and the integration within and across the other LAs. The aim of teaching NS is to make learners aware of the products or systems of ideas pertaining to NS that surround us (Collette & Chiappetta, 1994:35; Farmery, 2005). Learners should be encouraged to wonder how something functions or why specific phenomena in the material world act or occur in a certain way (Stallings & Ottinger, 1994). This involves the three LOs of NS, which means that educators should formulate scientific problems based on the material world to stimulate learners' interests and enhance learning about the material world (Collette & Chiappetta, 1994:30-35; DoE, 2002:7). Learners would be taught to use scientific tools in terms of LO1 and its accompanying ASs. In addition, learners need to use flexible learning methods such as the traditional methods, which entail consulting experts or educators about any problems they have encountered in the material world (DoE, 2002:8).

The problem approach (DoE, 2002:8-9) in teaching and learning is one of the basic tenets of NS in teaching and learning as prescribed by the NCS (DoE, 2002). Learners need to be encouraged to raise questions about objects or phenomena that surround them, which is the definition of natural science studies (Collette & Chiappetta, 1994; DoE, 2002:23&28). The problems learners pose should be used as one of the ways to guide the development of NS SKAVs. Educators should develop interesting and thought-provoking ideas involving the use of the process skills of NS. Learners should realise that NS involves studying or learning about the objects or phenomena around them (Stinner, 1992). Not only will this arouse the learners' curiosity (Boujaoude, 1995:46-47; DoE, 2003), it will also help learners and educators to realise that it is easy to create NS-oriented questions using the core knowledge and concepts of NS. The foregoing aspects will enable learners to learn more about other LAs for integration to enhance teaching and learning. The situation described above would be possible when educators use the three LOs of NS and their accompanying ASs and apply integration within and across the LAs to support their arguments or views. Mastery of the NS LA is made possible by the core knowledge and concepts of NS to inculcate the various SKAVs. Consequently, learners will be able to develop the following attitudes and values regarding the scientific process skills:

- Observe-**look**
- Ask questions-**think**
- Suggest a theory-**guess**
- Plan and do experiments-**try**

The above aspects will create an environment conducive to learner-centred and process-oriented learning. In addition, it has been shown that the three LOs of NS underpin the principles of the NCS (DoE, 1997:2-3). Furthermore, the above aspects will be aligned with what the NCS wants our learners to become and be (LO3 and Specific Aim 3 of NS).

2.4.2 Natural science learning area

This section will focus on all the relevant aspects of the NCS in the South African education context regarding the LA NS. The aspects are as follows:

- Scientific process skills and their assessment standards (NS LO1).
- Scientific knowledge and its assessment standards (NS LO2).
- The teaching of the system of ideas or products of NS as human activities incorporating different world views such as the indigenous and traditional knowledge systems and modern NS and technology (NS LO3 and the accompanying ASs).
- The integration of theory and practice for the enhancement of learning and teaching that uses the field of knowledge as the LAs. This integration will be achieved if it is done within and across the LAs and is based on the underlying principles of the NCS of education and training. In education based on knowledge and training based on skills, what is learned is applied to different situations or is a link to real-life (DoE, 2002:2-3).

Chin (2005:1550) makes the following observations regarding the NS LA:

These science learning domains were: (1)science concepts; (2)attitudes towards science; (3)the nature of science; (4)the interaction between science, technology and society (STS); (5)process skills; (6)thinking skills; (7)application of science; and (8)technological devices.

The three LOs of NS and the accompanying ASs support lifelong-learning that means that they support the NCS principles. The core knowledge and concepts of NS help educators to use all the LOs and ASs of NS (DoE, 2002:62-75). Accordingly, the core knowledge and concepts of NS are made possible through using the three LOs and the accompanying ASs in teaching. In the process, they will facilitate integration within and across NS and the other LAs. Van Niekerk and Killen (2000:93) contend that: “This perspective suggests that the purpose of education ought to be to help students understand (make sense of) the world in which they live.” The purpose of the NCS is to equip all learners with the necessary competencies and orientations required for future success (DoE, 2002; Yager, 1990). Bentley (2000:51), emphasise that the learner-centred approach in NS can help “Any children enjoy and find science rewarding to learn because it satisfies a deep curiosity about the material world.” This type of learning supports the SKAVs. McComas (2006:29) differentiates between the cognitive, affective and psychomotor domains that define the aspects of learning SKAVs as:

- ☐ Psychomotor-**skills**
- ☐ Cognitive-**knowledge**
- ☐ Affective- **attitudes and values**

Chang and Cheng (2008) and Howie and Jones (1998:11) refer to comparative studies on NS achievement using the TIMSS (1999 and 2003) based on the three LOs of NS for the improvement of teaching in schools in various countries (House, 2002). Regarding benchmarks tests, Rezba, Sprague, Fiel, Ronald, Funk (1995:x) point out, “Benchmarks are goals that serve as the core of the knowledge, skills, and habits of mind that contribute to the scientific literacy of all students.” The process skills (LO1) of NS, along with knowledge (LO2) that was produced by LO1 and LO3, which include scientific values and attitudes that define the nature of NS.

The three LOs of NS can promote scientific literacy by encouraging educators to teach learners to use process skills by interacting with the material world, for example, by touching objects and measuring the length of their classrooms (LO1). Importantly, they should engage with and use the products of NS or systems of ideas (LO2), for example,

by using principles, concepts and principles by, for instance, predicting the results of experiments and discussing and designing experiments in their classrooms. In addition, they can become interested in NS (LO3) (values and attitudes), for example, by proving previous theories and by being willing to read more about NS issues (LO3). Awareness is created of the ability of NS to provide an explanation and to facilitate understanding of the material world (Gilbert, 2006:415 & 474-475). Learners employ various ways of communicating in NS such as symbols, mathematical formulas and visual demonstrations (like graphs) that are all means of scientific communication (DoE, 2002:48-50). In the process, the three LOs and accompanying ASs of NS would be applicable as well as integrated within and across the LAs.

Educators should realise that LO1 (NS) is used for teaching and learning that involves “*how I teach or learn*” (LO1 of NS is How). This will include how educators teach aspects such as concepts, laws, principles and facts. LO2 of NS is concerned with the “*what issue*” (LO2 of NS is what) involving aspects such as concepts, laws, principles and facts. This system of ideas explains how the material world functions and of what it consists. Educators should share with learners that NS is the only way of knowing and understanding the material world. This means that LO2 of NS says something about the material world, which includes the universe, plants, animals and learners themselves. In other words, LO2 entails aspects such as naming and explaining the material world. That explains why in LO2 the themes or strands are called scientific knowledge. In addition, LO1 and LO2 of NS look at the impact and biasness’ of NS on the community, the environment and technology.

In SA, the NCS NS curriculum includes societal and technological problems such as HIV and drugs (DoE, 2002:2; DoE, 2002a:6-8; Howie & Jones, 1998:8; Trefill& Hazen, 1998:2). The core knowledge, concepts and unifying statements make it easy for educators to interpret and apply the four themes or strands of NS in teaching (DoE, 2002:61). The core knowledge and concepts of NS will make it possible to use perspectives in teaching for educators. They also make it easy to use the environment whether the school is situated in an urban or a rural environment, in the interpretation and application of the four teaching themes. The core knowledge and concepts of NS will help educators to achieve the three LOs of NS and

integration within and across the LAs. In addition, they will dispel the myth that science is a difficult or strange LA since as “The public perception of the natural sciences is that it is difficult and reserved for the select few who may have been gifted with superior intellects” (DoE, 2003:31). Learners will therefore learn about abstract concepts (Boujaoude, 1995; Howie & Jones, 1998:9; Ward, Roden, Hewlett, Foreman, 2005; Yager, 1990) such as viruses, electrons and gravity.

Abstract and concrete concepts can be developed in perspectives (Rens, 2002). Rezbaet *al.*, (1995:x) have the following to say about perspectives “Students with differing learning styles should have varied opportunities to demonstrate what they know and are able to do in science.” This means that developing, teaching and learning are lifelong activities (the underpinning NCS principles). This brings us to the point that teaching should be based on the ASs of NS (the other LAs’ ASs) and is based on the learners, their daily experience or the immediate environment should be considered (DoE, 2002:61-75; Potgieter, 2008). Asmal (DoE, 2002a:1) confirms the above as follows:

It encapsulates our vision of teachers and learners who are knowledgeable and multifaceted, sensitive to environmental issues and are able to respond to and act upon the many challenges that will still confront South Africa in this twenty first century.

If educators can understand what the ASs of NS or the ASs of other LAs entail, they can implement and interpret the NCS effectively so that learners can become scientifically literate (Boujaoude, 1995:46). That also means understanding the policy documents (the NCS or the RNCS for schools) of the DoE if they are able to read and understand the documents’ competence descriptions (DoE, 2003:64-75). In addition, the standards and practicability of the purpose of teaching NS (creating scientifically literate learners) should be developed through the three LOs of NS and the accompanying ASs, with due consideration to the environment in which the school is situated (DoE, 2002:5). This will show that the competence descriptions and philosophical principles underpinning the NCS curriculum can be interpreted and understood through the policy and guide documents for schools (DoE, 2003:5-14).

White Paper Six (WP6) on inclusive education stresses the formation of a school base support team (SBST) that can be used effectively to address how to teach as well as how to approach any learning barriers or problems experienced by the learners (GDoE, 2004). This can be achieved by the intervention of the SBST of the school, that entails encouraging the achievement of the 3LOs of NS and its ASs and those of other LAs. Educators should understand that intervention means improving teaching and learning and also tracking learners' progress. The school assessment team (SAT) should monitor the progress of teaching in the school. This means that the SAT should encourage educators to use questioning methods such as open-ended questions, simulations and interviews based on the LOs and ASs (Spady & Schlebusch, 1999:42-43). This will develop learners who can use communicative methods in NS such as graphs, models and diagrams, through the use or mastery of the 3LOs and by achieving the ASs of NS and integration within NS and across the various LAs. This will develop positive attitudes and values such as the enjoyment of NS. In addition, the integrated quality management system (IQMS) should be used for the improvement of teaching and developing educators. DoE (2001:11) states the following about the IQMS: "Human capacity and development are the central aspects of WSE."

2.5 AIMS OF THE NCS FOR NS

Learners should comprehend and explain the material world using the three LOs of NS and accompanying ASs and integrating within and across (DoE, 2002:2). The core knowledge and concepts of NS are significant to teaching and learning activities, local environment and globally of the material world. LO1 of NS is concerned with planning, doing and reviewing with regard to the material world. LO2 introduces the products or system of ideas of NS using the core knowledge and concepts of NS LA. The core knowledge and concepts of NS provide clarity on the themes or strands of NS that are divided into two bands. In the FET Band, the two NS subjects build on the foundation laid by the four themes or strands depicted (DoE, 2002:5-6) of the scientific knowledge (LO2) in the GET band. Importantly, the physical science curriculum builds on *energy and change*, *earth and beyond* and *matter and materials*. Life Sciences expands on the theme of *life and the living* in the GET band. The physical and life sciences' LOs and ASs ensure progression (as one of the tenets of the NCS principles) by linking directly with the GET band.

Life and physical sciences will not only reinforce the foundation laid in the GET Band (intermediate and senior phases); it has the potential to develop learners with general knowledge, specialised knowledge and process skills (DoE, 2006a:11). Process skills and scientific knowledge are developed through problem-solving activities (based on the LO1 ASs and LO3 ASs). This allows learners to follow career paths related to NS, while not restricting them to that field. LO1 and the accompanying ASs call for a closely defined problem or concepts based on the themes or strands or system of ideas or products of NS. LO3 and the accompanying ASs of NS are aimed at developing learners who can solve scientific problem based on different worldviews (DoE, 2002:11). The themes or strands below can be easily taught using core knowledge and concepts of NS to let NS teaching relate to the material world.

Aspects such as concepts, laws, principles and theories are the products of human activity (DoE, 2002:11-12). Collette and Chiappetta (1994:0) classify the products or system of ideas of NS based on the three LOs and accompanying ASs as “The facts, concepts, principles, laws, hypotheses, theories, and models [that] form the content of science. These ideas possess their own specific meaning, which cannot be understood apart from the processes of inquiry that produced them.” Trowbridge, Bybee, & Powell,(2004:81) stress the importance of the three LOs of NS and the accompanying ASs thus:

For example, scientific concepts guide investigation; technology enhances accuracy of data; scientific explanations use evidence, logically consistent argument, and propose, modify, or elaborate principles, models, and theories in science; and science advances through legitimate scepticism.

With regard to the three LOs of NS and accompanying ASs, Trefil and Hazen (1998:2) explain that: “Science gives us powerful tools to understand how our world works and how we interact with our physical surroundings.” LO3 of NS is meant to develop knowledge, appreciation and respect for the environment, society, science and technology. This will then develop the learners’ knowledge, appreciation that NS is a human activity and respect for the two worldviews (DoE, 2002). In addition, learners will learn to be sensitive to

cultural beliefs, prejudices and practices specifically in their communities as well as those that are found globally.

Through the three LOs and accompanying the ASs of NS, educators will develop learners who can ask many questions about the material world. Answers to the questions can be developed by reading different LTSMs (based on different worldviews). Through questioning and reading, learners will develop so that they can evaluate information pertaining to the material world. Teaching learners to read different LTSMs and questioning will develop learners' attitudes and values regarding the different viewpoints employed in interpreting the material world. House (2002:281) makes the following assertion regarding the improvement in teaching and learning of NS:

With regard to the teaching activities used in typical science lessons, the use of three specific learning practices (use things from everyday life in solving science problems, students do an experiment or practical investigations in class, and the teacher gives a demonstration of an experiment) were positively related to students' science achievement test score.

Educators using the 3LOs and the accompanying ASs of NS and integrating within and across the LAs will develop the knowledge in learners that NS is a human activity (through integration). That will be done based on the history of science (Meadows, 1987:6). Meadows asserts that, "The history of science can help here by providing some of the background, so that how scientists work becomes clearer. Science also has a unique historical property – its worldwide acceptability." The study of different cultures renders NS less neutral and gives it its dynamic nature. The above objectives will be possible through the achievement of the 3LOs as well meeting the requirements of the ASs of NS as well as their integration with the other LAs' LOs and ASs. Learners will realise that NS is not a neutral LA as it is influenced by the culture in which it is practised (Collette & Chiappetta, 1994:31).

In the past, prior to the introduction to the NCS, teaching was done to develop learners' memory capacity, in terms of teaching learners to recall and memorise. Learners were then deemed successful in terms of the results of paper and pen examinations. This resulted in the situation that educators and learners could not integrate what they had learnt in class

with what was outside the class. Educators should know the DOs and COs, LOs and the ASs (Specific Aims for CAPS) of the LA structures that would enable learners to succeed after leaving school. As they already possess chunks of LA information, the integration of these LAs will bring about one body of knowledge. The NCS is based on the premise that educators should develop learners who have mastered a range of SKAVs by achieving observable outcomes based on critical outcomes (COs) and developmental outcomes (DOs). It is important to note that integration will enhance the interest of learners in their LAs. An important aspect will be that their learning will be positive, as it will entail looking at all the LAs. NS can be developed as one of the main LAs that describe or explain the material world. LO3 of NS accommodates and assimilates different viewpoints such as cultural and religious viewpoints. It is significant that all the LAs explain the material world. It is important to note that the LOs and ASs of NS accentuate the interrelationship between NS and the other LAs (DoE, 2002). The diverse cultures in our country (SA) can have an influence on making sense of the material world (Whitelegg, Thomas & Trensman 1993:236). This will remove the general perception that males in the Western world dominate NS by including diverse cultures. Whitelegg *et al.*, (1993:245) reach the following conclusion regarding diverse explanations:

Thus, if only the public was properly informed and understood science better people would have a more positive view of what scientists say and do, and this would be reflected in wider popular support.

Diverse cultures make sense of the material world through art, religion and language. These branches of learning can provide different explanations of the material world from African, Eastern, Western and ancient perspectives. In LO3, the material world can be developed in terms of religious practices, as well as in terms of various scientific and artistic approaches (DoE, 2002). The above objectives can be developed by using hierarchies or perspectives in teaching and learning activities. In teaching and learning, educators should base their teaching on the ASs of the LA. Jegede (in Gilbert, 2006:357) states “The values, ethos, practices and perspectives of science for interpreting nature are a part of science education.” NS is one of the LAs in the GET band, in the foundation phase (grade R-3) NS and the other seven LAs are used for integration purposes (DoE, 2003:43; 59; 75). In the GET band, eight

LAs have LOs and ASs to achieve the principles of holistic teaching and learning that underpin the NCS (Yager, 1990: 53).

Educators were introduced to C2005 that was subsequently revised and named the NCS (that included the FET band, grades 10-12) after which the Revised National Curriculum Statement (RNCS) (the GET band) was introduced. Senior subject advisors and coordinators of the DoE as well as of the Gauteng Department of Education (GDE) who held workshops, informed educators that they should not refer to it as the RNCS, but as the NCS. This is indicative of problems with the interpretation and implementation of the NCS. The reasoning behind this is that if it is changed they should call the RNCS the “re-revised” curriculum. What is even more problematic for educators is that the policies sent to them in the GET band are referred to as the RNCS whereas in the FET they are referred to as the NCS. The improvement of the NCS clearly lies in the LOs that indicate to educators “*What to teach.*” The definition provided by the DoE (2002:15) provides clarity: “The **Assessment Standards** are ways in which learners demonstrate the achievement of the NS LOs.” In addition, it might help to enhance their socio-economic development. Learners will learn about the history of different cultures or societies concerning the solving of problems or about their struggle for survival. They will also learn about the improvement of the material world. This will develop the ability in learners to use indigenous and traditional knowledge systems as well as modern science and technology.

The NS LOs and ASs are there for the above to happen. Importantly, the integration of the LOs and ASs within and across the LAs will make teaching and learning relevant and interesting for learners. Gilbert (2006:475) makes the following comment about integration as “An emphasis on practical work and application has led several countries to pursue innovations that accent cross-disciplinary approaches, often called “integrated” science.” This approach will help to develop learners who can apply what they learn in one LA to other LAs. For instance, the application of the above will enable learners to apply specific problem-solving skills to their lives. Stallings, &Ottinger, (1994:21) state that the purpose of the NCS is “...to produce well informed citizens who are critical thinkers and are able to apply what they learned in a variety of areas.” It is evident that DoE (2002:7) places a strong

emphasis on teaching and learning, the development of critical thinking, self-discovery, constructivism and cooperative or team learning (Spady & Schlebusch, 1999:60-67). The content is important but it is not the only objective in learning. Teaching and learning is expected to apply the subject's content in meaningful and appropriate ways by using the LOs and ASs. The previous education system was characterised by fragmented content or knowledge that could be improved. In contrast, integration can include certain issues and problems that connect and impinge on other LAs in learning is central to the NCS.

2.6 THE IMPORTANCE OF NS

Educators teach learners by demonstrating knowledge and understanding of the material world through the three LOs and the accompanying ASs of NS. The three LOs embody the process skills of NS, which will entail the use of scientific tools, scientific knowledge, which clarifies the system of ideas or products of NS and the history of NS to realise that NS is a human activity informed by different worldviews. Regarding the three LOs of NS, Trefil and Hazen (1998:3) assert as "Science is a way of asking and answering questions about the physical universe. It is not a set of facts or catalogue of answers, but rather a process for conducting an on going dialogue with our physical surroundings."

The process of teaching NS takes place against the backdrop of certain philosophical perspectives, while keeping the social implications of NS in mind (Jenkins, in Ogunniyi, 1996:138; Osborne, in Palmer, 1997:76). Significantly, Osborne spells out the importance of using core knowledge and concepts of NS in teaching "The ability to relate ideas to a range of relevant contexts in everyday life is an important skill that children need to develop if scientific concepts are to have any significance for them." Barker *et al.*, (1996:49) explain the necessity of teaching and learning in different ways (core knowledge and concepts of NS) "The fact that people do not act as isolated, scientifically rational individuals means that if their behaviour, and their scientific literacy, is to be understood, it must be understood using a variety of concepts, explanations and perspectives." In addition to assuming, what the NCS envisaged educator (DoE, 2002:3), the educator should also have knowledge of the structures of all the LAs. This will enable educators to improvise when there are no LTSMs available at the school. This means using anything that is available in the learners'

environment or whatever they come across. Barker, Clay, & Fox, (1996: 25) give the following advice on how NS can be developed effectively using the core knowledge and concepts of NS:

Nobel Prize winner, Richard Feynman, identified playing around experimentally, switching representations, being alerted to noticing things, having interesting discussions, translating ways of seeing and imagining as important aspects of his developing interest in science (Sykes, 1994:33).

The teaching approach that is both learner-oriented and learner-centred is used when teaching NS to learners. Barker *et al.*, (1996:20) have the following to say in this regard:

To move towards success in education children must confront, make sense of, and then take possession of significant aspects of a whole range of literacies - ways of articulating and interpreting meaning-from basic print-literacy and numeracy, to other more subtle and complex literacies from fields like science and technology, art, music, history, health sciences, and geography. There are also other emerging and competing fields such as environmental education (eco-literacy) and computer literacy. Not only do learners have to do this from the perspectives of the disadvantages and impoverishment, but also they are expected to do it mostly in a language that is not their own.

Therefore, the teaching and learning of core knowledge and concepts of NS is more important than knowledge of a large number of NS products or many laws, theories and facts. The core knowledge and concepts of NS can be divided into two categories; the first category is concerned with the broad consideration of the social, economic, cultural and environmental perspectives of learners. The second includes assessment and learning using examples, assessment strategies such as simulation, projects and presentation, the language used, with due consideration of what WP6 contains about inclusive education and addressing barriers to learning (DoE, 2001). That means that the core knowledge and concepts of NS explain the phenomena that learners come across and experience in real life.

The core knowledge and concepts of NS will develop knowledge in learners of how the material world operates. In turn, the teaching and learning of the material world will show

learners that scientific knowledge is dynamic. This dynamic nature can be developed through its historical treatment (Collette & Chiappetta, 1994:31). This will mean teaching the scientific revolution started by scientists such as Galileo and Isaac Newton, because they built the foundation for NS (Meadows, 1987). Educators should instil in learners the knowledge that NS is a unity as its products or systems of ideas apply everywhere. Learners can use the core knowledge and concepts of NS to consider scientific decisions or debates, such as human cloning or the culling of elephants, for themselves. That means that learners can use the core knowledge and concepts of NS to improve their own lives as well as their environment. Barker *et al.*, (1996:22) make the following suggestions about the core knowledge and concepts of NS:

We need to:

2.6.1 Talk about science content, science concepts, the conventions of science discourse, and the science is written.

2.6.2 Take account of talk about teaching science and science learners; talk which encompasses pedagogy and curriculum.

2.6.3 Think carefully about the relation between languages and science learning.

2.6.4 Talk about the fact that reading, writing and talking about science (science literacy) occur in more than one language.

2.6.5 Talk about reading, writing and science process skills, where learners also use different language functions.

2.6.6 Talk about how all these things come together as children try to

Make sense of science and teachers attempt to make science accessible and comprehensible to children.

2.6.7 Consider how we can communicate our shared understanding to a wider audience and engage in a broader debate.

2.7 ASPECTS OF SCIENTIFIC LITERACY

As mentioned previously, the NS LA has 3LOs and accompanying ASs. LO1 includes basic and integrated process skills, as well as investigative process skills. LO2 includes scientific knowledge as themes or systems of ideas or the products of NS. LO3 is concerned with NS as a human activity and different worldviews. Through the three LOs and the ASs of NS,

scientifically literate learners will be developed regarding the use of:

- Process skills-hands-on
- Scientific knowledge-minds-on
- Being and becoming-hearts-on

All the LOs of NS include SKAVs that are integral to the NCS. The NS curriculum is designed for the head to think scientifically, the fine arts curriculum for the heart to feel (under which attitudes and values are implied); whereas the practical arts curricula should be designed for hands-on activities or processes (Erickson, 2008; Jegede&Okebukola, 1991). This means that learners have to develop the cognitive, psychomotor and affective domains of process skills; the cognitive, psychomotor and affective domains in scientific knowledge (such as using computers to search for information concerning any theme of NS). They also have to develop their cognitive, psycho-motor and affective domains regarding the impact of NS on people, the environment, technology and society and how they can use NS knowledge to improve their lives. Trowbridge *et al.*, (2004:149) make the following comments about the three LOs and ASs of NS:

If we look at science classes as a place where students can use their fertile minds to solve problems, gather data, explore new avenues, or create different solutions, we will find that they respond favourably and learn science. There will be some excitement in every class as students look for changes in things they are growing, see results of an experiment, or learn of some exciting information that relates to the natural or designed world. Students are curious and responsive to new challenges.

2.7.1 Process skills of NS

Process skills are concerned with ways of finding information, either deductively or inductively. Deductive methods entail working from specific to general information and inductive methods entail working from general to specific information. Process skills consist of basic and integrated skills and include the investigative process skills that are applicable in this approach to teaching and learning NS. This means that educators should know these approaches that include the process skills of NS and integration with the technological process skills such as *investigating, designing, planning, making, evaluating and communicating* (IDPMEC) will enhance learners practical skills (DoE, 2003). To emphasise

scientific knowledge and guide learners in learning how to view the material world, teachers use LO1 of NS as scientist tools. DBE (2001:18) defines LO1 of NS as “Learners must be able to plan and carry out investigations as well as solve problems that require some practical ability.”

The basic, integrated and investigative process skills are tools employed in solving the mysteries connected with the material world (Harold, 1993:1). Learners will be equipped to understand and explain the nature of NS; this will help to enable learners to find objective evidence for everyday phenomena. This means that after a lesson employing the deductive approach and educator-centred teaching, learners can use these skills when looking for objective evidence for certain phenomena. The understanding facilitated by the process skills learners acquire will allow them to ask themselves questions like: “What do I know?” and “How do I know it?” on an on going basis. This will develop learners who ask themselves “How is what I know different from what I felt I knew earlier?” This will allow conceptual development to take place and learner-centred and process-oriented to take place during learning and teaching. Ollerenshaw and Ritchie (1997:3) have the following to say about the study of NS “Science is an exploration of the cosmos to discover or explain what, why, when, where and how things happened, are happening or likely to happen within it.”

In addition, Ollerenshaw and Ritchie (1997:3) refer to the dynamic nature of NS and the fact that “Science advances by testing theories and predictions to gain new evidence.” Learners are introduced to the range of tools scientists use to achieve LO1; Bloom’s taxonomy is also included in LO1 of NS that covers the cognitive, psychomotor, social and the affective domains (Howie & Jones, 1998:71-78). The process skills of NS include the SKAVs that involve the cognitive, psychomotor and critical thinking skills. The above process skills will allow learners to use higher order (integrated) process skills such as decision-making, evaluation and analysis (DoE, 2003:3). The process skills in (DoE, 2003b:20) are the focus of all NS learning as well as assessment both inside and outside the classroom. Consequently, the focus will be on the construction and application of scientific knowledge (LO2). This will show that LO1 is best developed within the context of expanding the framework of LO2. Learners developing LO1 should be able to work with others to achieve a common goal (that means the promotion of attitudes and values,

which is LO3 of NS). The educator will be required to give guidance in information searching; this provides clarity to the integration within NS. Where there are no resources available, an educator should improvise by using materials found in the scrapyard or in the learners' environment. In addition, the educator should have access to scientific journals and NS websites at the school and should be able to make some copies for learners to use. The broadened access to adequate and sufficient resources will improve the cost-effectiveness, time management and performance of the school.

Educators should teach learners to solve problems involving the identification and analysis of the questions at hand and then devise strategies to reach an answer. Furthermore, basic, integrated and investigative process skills are strategies and techniques that can enable the development of previous and new knowledge. In addition, these skills are used for correcting previous inaccurate knowledge or misconceptions or for providing alternative frameworks. That means they can also transform abstract concepts into concrete concepts. This is demonstrated when learners can infer the traces and impacts of those abstract concepts. The core knowledge and concepts of NS make it easy to teach abstract concepts. It is also important to note that the process skills are iterative. This means that NS process skills will enable hanging concepts to become part of the learners' previous knowledge by developing more concepts in learners. In sum, the success of LO1 can be developed by means of the ASs of NS (LO1) (DoE, 2002:13-14). The ASs of LO1 entail assessing the following: planning investigations, conducting investigations and evaluating data and communicating findings (DoE, 2002). The ASs of LO1 are as follows:

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- Planning
- Doing
- Reviewing the material world

Learners, who have achieved the ASs of LO1, can use their own initiative and are innovative regarding problem solving. Achievement of LO1 is demonstrated when learners can solve problems both in their assessment tasks and in their everyday lives. The DoE (2002:8) lists the following problem-solving aspects:

- Making

- Observing

Surveying and measuring

- Comparing
- Determining the effects of certain factors

These problem-solving skills will increase the development of learners as reflected in COs and DOs (DoE, 2002:1-2). The foregoing means that learning and teaching in NS should be done using the three LOs of NS, in conjunction with other LAs for integration to ensure that learning and teaching cater for all learners in terms of diversity and various socio-economic and cultural contexts.

2.7.2 Scientific knowledge

LO1 supplements LO2 in terms of how the material world's functioning and composition is taught. The 'material world' is a complex concept and in the GET band the teaching and learning of the concept is categorised into four strands or themes. The themes or strands are simplified and each is explained in terms of its context. The specific contexts will be made clear by the ASs of each LO of NS. It is essential to mention the impact that NS has had on technology and society, known as science-technology-society (STS) in NS education. The above approach makes it possible to teach in a holistic way and identify NS as a LA. The STS are made possible by the core knowledge and concepts of NS (GICD, 2004:138).

A number of interesting changes have occurred (Bentley, 2000: 27-36) in certain subjects (LAs), where parts of different subjects have been integrated with each other, for example, geography has been integrated with *planet earth and beyond*; chemistry with *matter and material*; biology with *life and living* and physics with *energy and change*. This shows how NS has integrated the previous subjects, which means that LO2 can be used in contexts to develop knowledge of the material world and to develop learners' complex competencies. In addition, educators will use NS to enable learners to understand the relationship between STS. Furthermore, LO1 will develop learners who can use LO2 for the benefit of the community. The benefits will become evident if learners can explain to their parents or siblings how NS has brought about positive and negative changes in their lives.

The inclusion of STS topics would include moral or political issues such as pollution, alternative energy sources and conservation. In the United Kingdom, learners can study subjects such as energy education, nutrition education, environmental education and health education. Noddings (1995:37) cites Dewey (1993) as follows:

Dewey did not recommend abandoning the traditional subjects of the curriculum, but he wanted them to be taught in a way that makes them genuine subject matter. They should be presented so that students can use them in purposefully working through some problematic situation.

The core knowledge and concepts of NS enhance learners' understanding of the intersection between STS. In the previous education system, health and environmental education were introduced mostly in primary schools and mainly in African languages such as "*tikologo*" (a Setswana concept for environmental education). On a more holistic NS curriculum, Noddings (1995:37) points out "Dewey wanted students to experience a personal unified curriculum - one that makes sense to them in terms of human experience and, particularly, in terms of their own experience." That means learning and teaching should be in line with what learners experience or come across. Trowbridge *et al.*, (2004:79) moreover the core knowledge and concepts of NS thus "The goals for teaching science indicate a strong emphasis on environmental concepts, world problems, decision making, and interdisciplinary studies - all areas related to the goal of teaching students to deal with societal issues."

The aim is that learners will be learning NS that is applicable to and based on their everyday life experiences. The NCS has included and integrated them in the NS previous subjects such as environmental and health education that are explained through the core knowledge and concepts of NS. This can be seen when learners learn concepts such as '*house insulation*', '*acids*' **and** '*indigestion*'. The development of NS (LO2) can be assessed by means of its ASs based on the underpinning core knowledge and concepts of NS (DoE, 2003:74-84). Therefore, educators will base their teaching on the core knowledge and concepts of NS of LO2 by using the ASs of LO2 to:

- **Recall meaningful information.**

This assessment standard recognises that learners' ability to retrieve connected ideas is still a valuable intellectual skill. Learners are not permitted to memorise the NS system in terms of the NCS that has no meaning or connections for them.

- **Categorise information**

If learners can categorise information, it means they can sort, group and classify items. This AS is used extensively in NS because it is an effective tool for reducing the great complexity, which scientists and technologists encounter in the material world.

- **Interpret information**

This means learners can change information from one form to another, for instance, when they use NS communicative methods such as describing graphs in words, symbols and changing pie charts into tables (Cooper, 1978:7-8). Learners show evidence of having achieved this assessment standard when they can explain the different forms of graphic information in their own words and can find appropriate examples of this type of media. Furthermore, they should be able to make inferences and predictions from the graphic information and lastly, relate it to other information.

- **Apply knowledge**

This AS evaluates the ability of learners to select and use knowledge in new and unfamiliar situations. They should be able to select and use entities (Cooper, 1978) such as concepts, rules, methods, theories and mathematical formulae correctly to produce products or solutions.

The aim of the above activities or processes is to develop learners that can collect abstract and concrete core knowledge and concepts of NS from various sources and use them, after which they should be able to organise and analyse the information obtained. The above processes can also help to develop the ability in learners to use the core knowledge and concepts of NS as they related to real life situations. LO2 is important for learning and prepares learners for life, for example, in social and economic situations. The dynamic nature of NS knowledge in the twenty first century has led many nations of the world to realise the importance of NS in all spheres of life (such as using the core knowledge and concepts of

NS) (Mullis, Martin, Ruddock, O’Sullivan, &Preuschoff, 2009:53-80). It is important to note that citizens who are not scientifically literate are not marketable or productive; such individuals will be at a disadvantage regarding the use of technology in their lives or in their workplaces. Technology can help learners and educators deal with both deductive and inductive knowledge. Learners will thus be able to or be expected to apply the major products or systems of ideas of NS such as the laws, principles and concepts of NS to explain the material world and to make verifiable hypotheses. Therefore, learners should be taught and given opportunities to apply or solve problems using a system of ideas pertaining to NS in class or present them through different assessment strategies (DoE, 2003: 17). Trowbridge *et al.*, (2004:82) confirm this as follows “The purpose of science teaching is to help students understand and act on the various issues and challenges they will confront as individuals and as citizens.”

2.7.3 Scientific knowledge in learning and teaching

Educators should make learners aware that using a system of ideas or products of NS such as the core knowledge and concepts of NS or themes or strands to do things such as naming, explaining and describing the material world in terms of like concepts, theories, principles and models. These products of LO1 (that is after using the scientist’s tools, as is LO1 of NS ASs) are utilised in explaining and describing how the material world functions or what it entails. DBE (2011:16) describes LO1 of NS (CAPS specific aim 1) as “The scope of the knowledge that learners should acquire include knowledge of the process skills related to carrying out investigation.” This will lead to a situation where learners will realise that the material world is orderly and real. This aim can be realised through the two different world views in various countries (namely, the traditional knowledge system and the IKS, on the one hand and modern science and technology, on the other hand); consequently, educators and learners should be able to use the process skills of NS to determine whether the products of NS provide objective evidence. In this regard, flexibility is important and entails using different LTSMs as part of comprehensive explanations or by using them as guidelines.

Importantly, educators need to be familiar with a wide range of specialist vocabulary and terms. Sensenbaugh (1992:46) offers the following advice:

You and your students may find it helpful to keep the following three learning condition in mind when choosing the words to be singled out for direct instruction

1. First, some words represent a new label for an already existing concept. An example is the word 'indigenous,' for which your students probably already know the synonymous concept of 'native born.' Instruction in these new-label/ old-concept words may not be necessary for all students.
2. Second, some words engender in students a general idea of what a word means, but a technical definition is lacking. An example of such a word is "force." These old-label/new concept words are more difficult to learn than new-label/old-concept words.
3. Third, words such as "fulcrum" represent new-label/new-concept words-the most difficult words to learn because students must accommodate a new concept and a new label for these words at the same time.

Learners and educators should realise that knowing the meaning of a particular term or phenomenon does not mean one knows NS. The most important aspect is to know the meaning of a particular phenomenon, vocabulary item or term (Their & Davis, 2002). This will entail constructing the meaning through discovering how these phenomena, theories or terms relate to each other (DoE, 2002: 18-19). It will be apparent that learners can use process skills when they can differentiate between naming words such as *medulla*, process words such as *respiration* and symbols such as *mathematical formulas* (Driver *et al.*, 1994: 8-12). This will enable learners to understand that some concepts pose problems, particularly, abstract and concrete concepts. Abstract concepts such as 'electrons' can be studied through their traces and impact. Grasping what concrete concepts entail is more easily developed if they are observed in real life, such as insects that are easy to find and observe. That will be through the core knowledge and concepts of NS. The dynamic nature of NS has resulted insome words or concepts being changed from naming to process words.

In addition, some concepts have both everyday and scientific meanings Driver, RS, Asoko, Leach, Mortimer, &Scott, 1994: 8-12). If educators know, the structure of the themes or strands based on the core knowledge and concepts of NS it becomes easy for them to answer

(DBE, 2011:12-14) all types of questions, from the factual to the complex in NS. When answering a question, learners should know from which theme the question comes, that will make it easy to answer the question, based on the core knowledge and concepts of NS. Learners can understand formal concepts and should be able to achieve LO1 like in models and experiments. The themes or strands can be assessed by means of the ASs of NS based on the core knowledge and concepts. The ASs of LO2 require learners to:

- Recall meaningful information
- Categorise information
- Interpret information
- Apply knowledge

DBE (2011:16-18) mentioned the above ASs as skills to be used in teaching and learning activities. DBE (2011: 16) emphasise the ASs of LO2 as “The following cognitive (thinking) skills comprise the range of skills that all learners should develop in the context of working through the curriculum in a school year.” ASs will make it easy to know at which level teaching and learning must take place and this applies to assessment in NS.

2.7.4 NS as human activity informed by different worldviews

Educators need to teach learners how the products or systems of ideas of NS have come about through human activity (Collette & Chiappetta, 1994). Educators will use the history of NS based on different systems of ideas or products of NS such as Darwin’s theory of evolution and Newton’s laws. The core knowledge and concepts of NS will make it easy for educators to use the history of NS. This will make it possible to base NS on the material world. In addition, educators teach learners how the different worldviews will help them in studying NS. This will provide clarity regarding the way different societies learn about the material world. Sadler and Zeidler (2003:40) points out:

An underlying assumption of science education is that students should understand and experience the valuable products of science. However, discussions of scientific blunders and abuses can add another important dimension to science classrooms. These cases force students to evaluate the role of science within a society critically as well as the ethical ramifications of scientific work.

LO3 of NS makes it possible to study historical, environmental and cultural perspectives. It is important to note that the changes of the above over time will depend on political, religious and social factors. In addition, the experience of the community has an influence on the time (past to present and future-history), the cultural perspectives of South Africa and also on global and environmental perspectives (DoE, 2006a:4). DBE (2011:20) for this reason LO3 and accompanying ASs in teaching and learning activities, as “Learners must be exposed to the history of science and indigenous knowledge systems from other times and other cultures.” LO3 and its accompanying ASs should be clarified by educators to teach learners that the products or system of ideas are human activities (DoE, 2003:5). Furthermore, learners become aware of the different world views namely the IKS and traditional knowledge system on the one hand; and modern science and technology on the other hand. This will provide clarity to learners regarding how different societies solve their problems.

LO3 is meant to develop an understanding in learners of the interrelationship between NS, technology, society and the environment and can contribute to active debates and responsible decision-making. The above interrelationship will demonstrate to learners the importance and responsibility of humans becoming involved in such as environmental management, lifestyle choices, socio-economic development and technological development. LO3 will develop an understanding in learners of how developments in NS and technology affect the perspectives of the learners and the communities’ lives, and can reveal, together with LO1, the importance of NS and technology (Collette & Chiappetta, 1994:30). The interrelationships between NS, technology, society and environment will help learners to become problem solvers. Learners will realise that they will be adults in future and that in adulthood, no matter which problems they encounter, they can rely on the skills and knowledge learned at school (Collette & Chiappetta, 1994:41). The creative and critical skills they learn at school need to

be practised in life. The perspectives in cultures, social and religious factors will influence problem solving. The learners will be able to study and recall applications of old solutions that are still effective. This will mean that learners will be able to utilise two worldviews in their thinking. As mentioned before, the two worldviews are as follows:

- Modern NS and technology
- Traditional and indigenous knowledge systems (IKSs)

It needs to be emphasised that the above worldviews underpin the NCS principles. In turn, modern NS and technology are based on ideas and entities that underpin the process skills of NS and technology such as observations, investigations and designs. The traditional knowledge systems and IKS are based on the observation of phenomena that occur in spiritual, learning and teaching support materials (LTSMs) and physical areas. The NCS places a strong emphasis on learners to solve problems and think of alternative ethical procedures or about the impact of their decisions or solutions on the environment. The solutions can come from current ideas and practices in terms of different worldviews. The above will be possible if learners are using the two worldviews or revising the two worldviews.

Traditional and indigenous knowledge systems were previously not used in NS. However, NCS has now made it possible through its principles and the Constitution to emphasise both traditional and indigenous knowledge systems (DoE, 2006:27-30). The IKS and traditional system may reveal the experiences and wisdom of different cultures in the world. In SA, the IKS and the traditional systems respectively were formerly the ways of thinking and knowing (DoE, 2003:14). The learners will realise that all cultures and nations have fundamental needs to solve their problems and choose different methods of solving their problems (it can be a choice between the two worldviews). By presenting the two worldviews to learners, educators offer alternatives to learners. Learners will realise that all societies or communities have problems to solve based on their worldviews (Collette & Chiappetta, 1994:35). In this regard, societies choose various ways of solving their problems. DBE (2011:21) describes the importance of LO3 and accompanying ASs, as “The third aim of Natural Science, is to enable learners to understand that school science can be relevant to

their lives outside of the school and that it enriches their lives.” Progression in this LO3 is seen when learners realise that societies make choices in solving their problems based on the two worldviews. Their choices of worldviews to solve the problems will reflect their values and attitudes (good or bad), and reflect their wisdom or lack of it. Learners will learn that an increased understanding of the different values and attitudes influence societies’ choice of world view. In turn, the two worldviews will influence their development regarding their understanding of NS. The development in the NS LA based on LO3, can be assessed regarding the progress of finding solutions to problems based on issues such as environmental rights, human rights and the two worldviews. In this regard, Yapp (2003) cited by ASE (2007:4), remarks as follows: “Furthermore, to contribute effectively in tomorrow’s society, primary education should provide children with more languages, scientific and technological awareness and confidence, cultural sensitivity and media awareness.”

As learners develop concrete and abstract concepts in NS, they will start to realise how these concepts impact positively or negatively on their lives, on cultural knowledge, on the environment and on technology. In this way, they can evaluate indigenous and traditional knowledge systems on the one hand and modern science and technology. It is important to point out that the development of NS and technology has affected the lives of everyone, not the least of all of learners. Learners also learn more about issues that affect their lives negatively such as the infringement of the code of ethics when working with living things, such as cloning, genetic engineering and weapons of mass destruction such as atomic bombs and biological warfare. Learners should realise that the focus on NS has resulted in solutions to problems connected with electricity and water (as in our country, SA), poverty and diseases such as AIDS and TB. It is most important to show learners that NS is not dominated by Western cultures and males. In addition, learner development regarding LO1 and LO2, will help them realise NS is the quest for knowledge regarding the material world. This can help to develop learners who are ethically aware and responsible. This means that learners will be able to use process skills to learn about their both their own cultures’ taboos and other learners’ cultures in class. They will learn to view science as a human endeavour and will understand the sustainable use of the material world. The diverse cultures in our country can also have an influence on the clarification and understanding of the material world. That

means diverse cultures can make sense of the material world through art, religion and language.

This will show learners that NS is a human activity and is not biased in favour of a single culture. Furthermore, this can show that we can use different explanations for the material world as African, Eastern, European, Medieval, ancient and contemporary cultures (DoE, 2002). LO3 of NS allows learners to understand their identity and it allows learners to explain the material world using information to identify and discuss certain aspects regarding religious, scientific and artistic practices. This will be achieving through the core knowledge and concepts of NS by applying ASs of NS. Consequently, learners will experience certain societal issues in NS through LO3. The application of LO3 is evident in the learners that are taught and realise that NS is and has been a human activity throughout the history of science and how concepts such as ‘principles’ and ‘theories’ were addressed and the two world views have impacted on their community, environment, NS and technology.

2.8 INTEGRATION IN TEACHING AND LEARNING

Integration of the LAs (LOs and ASs) will ensure that the SKAVs aimed at in teaching and learning are achieved and are used for conceptual development. The integration of different LAs can be used to explain a concept from one LA in terms of another LA. The purpose of using integration based on the LOs and ASSs of the LAs is to enhance the LA that you teach, to contextualise the topics or themes on a broader platform to enhance meaning in teaching (Harold, 1993: iv). The core knowledge and concepts of NS will enhance the teaching of NS in real life situations. Once SKAVs have been developed, practised and assessed; they can be enhanced further and built upon in subsequent grades or phases in education. This will show the impact of the development of teaching on competence and maturity for learners or communities. Farmery (2005:77) describes the integration in NS as the improvement in teaching and learning as follows:

Science is an excellent vehicle for providing the basis for a topic, connecting learning in different areas of the curriculum, the approach known as the cross-curricular topic.

It is able to offer numerous opportunities for related work in many areas across the curriculum, although this is more relevant to pupils in the Foundation Stage and Key Stages 1 and 2 of the National Curriculum than pupils in Key Stages 3 and 4. Science is also a suitable vehicle for the development of the key skills that are used across the curriculum, and indeed into adult life, and is a meaningful context for the study of other individual subjects such as literacy and numeracy.

In addition, integration will lead to the enhancement of learning and knowledge and will help to cater for the local needs of learners, specific to their location. The integration of LAs entails learning and teaching holistically and results in the support of teaching in hierarchies or perspectives. Integration will prevent an overload in teaching and learning for educators and learners in the school. The above will only be possible if educators know the structures of the LAs. Educators will be teaching learners in order to understand that what they learn in class has an impact on their lives. Educators can teach using the products or system of ideas of NS and integrating within and across various LAs, so that problem solving can be done in terms of the core knowledge and concepts of NS. This will broaden the transfer of SKAVs in the class to the real world. Of importance is the fact that integration is possible with the help of phase organisers and programme organisers, which will facilitate integration (DoE, 2002:3).

Bentley *et al.*, (2000:255) explain the purpose of integration as “Deliberately planning integration related to your science program demonstrates to children the interrelationship between subject areas that they study.” Therefore, integration will be applicable to aspects that are similar or associated in some way. This means that without integration, NS is merely theory and will not be viewed as a human activity, and the use of different worldviews. This will help learners to gain authority over the material world (Whiteleggetal., 1993:236). Integration means that learners will be studying NS and they will be able to use process skills to develop scientific knowledge and to improve their environment and also acquire technological knowledge and attain balance in their lives. This will make it possible to use the contexts of learners and to implement the NCS in its present form. That will also mean applying what the learners already know and will entail life-long learning.

2.9 SUMMARY

The three LOs of NS are important in the process of developing scientifically literate learners and community. The ASs of the three LOs of NS place the emphasis on the level of achievement of the major (LO2) systems of ideas (such as the concepts, universals and laws of NS) and this is based on LO1 of NS in terms of the development of NS process skills. Consequently, the ability of learners is developed to use different communicative methods in NS based on the four themes or strands. Learners will be able to use the communicative methods based on integrating the themes (LO2 and ASs and LO3 and ASs) in solving problems. The above is made possible through the two worldviews. This will mean that educators ought to be flexible when considering the COs and DOs, and the principles underpinning the NCS curriculum. Successful learning will be possible if learner-centred teaching and process-oriented teaching based on the ASs (as they are action verbs) is used that focuses on the acquisition of problem-solving skills. One of the ways of achieving this will be by guiding learners to engage in activities that require enquiry, reasons and decision-making. This can be done through debates, practical work, presenting their work or projects in class and simulations. The above suggestions and practical ideas can be implemented for problem-solving.

Memorisation of information can be achieved after learners have extracted the information they need to memorise and they are able to recite what they have memorised. Important teaching and learning aids in this regard are worksheets, chalkboards, written notes and drill activities. Potgieter (2008) asserts that the principles of the NCS regarding teaching and planning are based on the SKAVs. The educators who follow Potgieter's (2008) ideas of applying the corresponding ASs to the LOs will be using NCS principles. Potgieter (1987:14) contends:

A syllabus is effective only to the extent that the examination is, for the student, truly a random representative sample of the syllabus as spelt out in the study package and if the student abilities tested are truly at the required cognitive level.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 OVERVIEW OF THIS CHAPTER

The study wants to inform about the importance of improving existing curriculums in our country (South Africa) and raise issues for attention of decision makers. This type of the study will enable policy makers in education to understand complex phenomena (NCS/CAPS) qualitatively as well as to explain the NCS/CAPS through amounts (quantitatively). Creswell and Plano Clark (2011:53) points out as, “Once the researcher has identified that the research problem calls for a mixed methods approach and reflected on the philosophical and theoretical foundations of the study, the next step is choose a specific design that best fits the problem and research questions in the study.” This chapter presents the strategies of investigation and inquiry about the interpretation and implementation of the learning outcomes (LOs) and assessment standards (ASs) for teaching and learning activities. The NCS requires significant changes in teaching and learning, that is applying the LOs and accompanying ASs from the LAs for teaching and learning activities. NS learning area (LA) has LOs and ASs to make teaching and learning activities learner-centred and process-oriented.

The sampling strategy and data gathering techniques used in the empirical inquiry are described in this chapter. Data was gathered by examining lesson plans, a questionnaire and focus group interviews. The lesson plan is the document whereby educators should implement and interpret the LOs and ASs for teaching and learning. The lesson plan activities are to be guided by the LOs and Ass for teaching and learning activities to be learner-centered and process-oriented and learning and teaching activities should be done by applying the learning outcomes (LOs) and assessment standards (ASs). The focus group gave educators in selected schools the opportunity to air their views about the application of LOs and ASs for learning and teaching activities. The questionnaire clarified biographical and demographic data regarding the school and validated whether the intervention had an influence on the application of the LOs and ASs.

3.2 Strategies of investigation and inquiry

This study engages a mixed methods design defined by Creswell and Plano Clark (2007:13) as:

The complexity of our research problems calls for answers beyond simple numbers in a quantitative sense or words in a qualitative sense. A combination of both forms of data can provide the most complete analysis of problems. Researchers can situate numbers in the contexts and words of participants, and they can frame the words of participants with numbers, trends, and statistical results.

The importance of using mixed methods design is to give clarity on what should be done in the selected schools as indicated by the policy document of the DoE (2003a; 2003b). Each method of research has its weaknesses and strengths. The use of mixed method provided clarity on what is happening and what is done in selected schools based on the LOs and ASs as specified by National Curriculum Statements (NCS) and allowed educators to share their understanding of the LOs and ASs in designing their teaching and learning activities. The understanding and application of the two documents (DoE, 2003a; DoE, 2003b) for NS learning area (LA) is intended to enhance the learners' curiosity and innovation. Woolley (2009:7) asserts that in the mixed methods design, "the quantitative approach is characteristically indirect and reductive; the qualitative approach is characteristically direct and holistic."

The three instruments for data collection are analysis of the lesson plan (document analysis), the focus group and the questionnaire. The mixed methods approach is an effective way to investigate and enquire (Creswell & Plano Clark, 2007:5) into the way educators are applying the LOs and ASs in the lesson plan. Contextualisation is provided for in the questionnaires by closed questions and in the focus groups by open questions. The three methods provide triangulation and thus give reliable information (Creswell & Plano Clark, 2011:211-212). The document analysis sessions is required to give clarity on the planning base of the lessons and demonstrated how the LOs and ASs were applied in the design of teaching and learning activities in selected schools. In the lesson plan a checklist was used to ascertain if educators in the selected school are basing their planning on the LOs and ASs. The analysis of the lesson plan indicated the activities educators are designing, in other words whether they are based on the LOs and ASs of NS and whether there is integration within and across

the learning areas (LAs) LOs and ASs. The lesson plan is a document that is guided by the learning outcomes and assessment standards for process-oriented teaching and learning activities. The focus group discussion, on the other hand, ascertained the opinion of educators about the use of the LOs and ASs in designing of the teaching and learning activities in selected schools. The questionnaire was used to consolidate the information obtained from the lesson plan analysis and focus group. Also, the questionnaire was concerned with the background or biographical information of educators and explored their attitudes and perceptions regarding the interpretation and implementation of the LOs and ASs in selected schools.

3.3 Mixed methods design

The mixed method design makes it possible to answer research questions and to give the answers to what kind and how many (Creswell & Plano Clark, 2011:19-49). The mixed methods and data from different instruments represents strategies which address the weaknesses of each approach (quantitative and qualitative) (De Vos *et al.*, 2011:439). Mixed methods strategies are aimed to capture different perspectives in the investigation (Creswell & Plano, 2007; Woolley, 2009). In this study the mixed methods allowed for comprehensive and holistic understanding of the application of the LOs and ASs in the selected schools. Through the quantitative approach the researcher determined what was happening in selected schools based on the planning and applying of the learning outcomes and assessment standards. The qualitative approach allowed the researcher to explore the interpersonal, cultural and social context holistically in the selected schools in Tshwane South District.

The strengths of each method (quantitative and qualitative) were taken into consideration in order to view how a selected school applied the LOs and ASs in their teaching and learning activities. The mixed method gave a comprehensive understanding based on the claims by the DBE (2011:23) that educators are familiar with the LOs and ASs. The focus group allowed educators to say what they thought of the LOs and ASs in designing the teaching and learning activities in selected schools. Educators are the ones to apply the LOs and ASs in their teaching and learning activities in order for a process-oriented and learner-centred approach. Lesson planning indicated the actual teaching and learning activities. The analysis of the

lesson plan and the enquiry in the focus group indicated the context of planning and teaching in selected schools. In addition, the challenges in selected schools were viewed based on the LOs and ASs and their interpretation and implementation were clarified by the questionnaire.

3.3.1 Mixed method on the NCS

The rationale for this approach is that the quantitative data and their subsequent analysis provide a general understanding of the designing of the teaching and learning activities in selected schools. The qualitative data and their analysis refine and explain the research problems results by exploring participants' views in more depth. The mixed methods design generated deeper insight (Creswell & Plano Clark, 2007:18) into the challenges in teaching and learning activities in the Tshwane South District in selected schools. Mixed methods allowed for cross checking what is happening in public schools and independent schools and their understanding of basic NCS underlying principles in the policy document for schools.

Webb *et al.*, (1966:3) suggests, "Once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced. The most persuasive evidence comes through a triangulation of measurement processes." The evaluation of both approaches (qualitative and quantitative approach) can extend the purpose of evaluation using triangulation. Triangulation of data took place through the three instruments (analysis of the lesson plan, focus group and questionnaire). Section A of the questionnaire was based on the context and demographics of the school and educators. DoE provided interventions on the NCS (DoE, 2002d:2) through policy documents (based on lesson planning like using the LOs, ASs and core knowledge). The triangulation indicated if the intervention was adequate (Musker, 1997, see section 2.2; Pretorius, 2008, see section 2.2; Spady, 2008, see section 2.4; Mgwebu, 2009, see section 2.4).

3.4 Conceptual framework

DoE introduced the NCS for successful teaching and learning in South Africa. The study gathered data by analysis of the lesson plan, a focus group with educators and a questionnaire in selected schools to explore the application of the LOs and ASs in teaching and learning (De Vos *et al.*, 2011:35-36). The lesson plan can help to understand how educators apply the

LOs and ASs for teaching and learning activities. DoE (2009:3-7) gives clarity on the application of the LOs and ASs for learning and teaching. The study is based on the NS LOs and Ass and the integration within NS and across other LAs LOs and ASs. The integration is used for enhancement and to avoid overloading of teaching and learning activities (DoE, 2009:11). Educator's lesson plans were analysed based on the LOs and ASs for the teaching and learning activities. The LOs and ASs of NS were analysed for the teaching and learning activities and if integration was used for enhancement of SKAVs. The grade 9 lesson plan were analysed for the achievement of all the LOs and ASs. DoE (2004:11) asserts that grade 9 is "the General Education and Training Certificate for compulsory schooling is a whole qualification for schools based on the extent to which the Learning Outcomes are achieved through the Grade 9 Assessment Standards." This is in line with what the NCS wants educators to do and apply the LOs and Ass (DoE, 2003a:16). The DoE (2003a:19) asserts as "The main features of the Learning Area Statement are the Learning Outcomes, the Assessment Standards that embody the knowledge, skills, values and attitudes required to achieve the Learning Outcomes and the "statements" of Core knowledge and Concepts."

The NS LA contexts are the 3LOs and ASs in teaching and learning activities. DoE (2002:4) asserts that the LO1 and accompanying ASs of NS is "To be accepted as science, certain methods of inquiry are generally used. They promote reproducibility, attempts at objectivity, and a systematic approach to scientific inquiry." LO1 and accompanying ASs indicate how educators should develop learners to use the scientists' tools during the investigative process to solve problems that they encounter in assessment or in their lives that affect them directly (see Section 2.7.1). Consequently, the DoE (2002:4) states, "These methods should be used including formulating hypotheses, and designing and carrying out experiments to test hypotheses." Educators are to develop in learners the competency to apply NS products or system of ideas in their lives (see Section 2.7.2 & 2.7.3). In addition, educators should apply LO3 and accompanying ASs (DoE, 2002:4) as:

Repeated investigations are undertaken, and results are carefully examined and debated before they are accepted as valid. Knowledge production in science is an ongoing process that usually happens gradually, but occasionally knowledge leaps forward as a new theory replaces the dominant view. As with all other knowledge, scientific knowledge changes over time as people acquire new information and change their ways of viewing the world.

LO3 and accompanying ASs are to be applied for learners to realise that NS is a human-activity and to allow for different world views (i.e., modern science and technology and traditional and indigenous knowledge systems, see section 2.7.4). DoE (2003a:20) emphasises that all the 3LOs should be applied in teaching and learning activities. The core knowledge and concepts of NS makes it possible to apply the 3LOs and ASs of NS in planning (DoE, 2002:61). The core knowledge and concepts of NS make it possible for educators to apply the LOs and ASs to learners' immediate environments (DoE, 2002:5 & 7). This will be enhanced by integration within NS and across other LAs (DoE, 2009:11). DoE (2002:5) asserts integration as:

Meaningful education has to be learning-centred and help learners to understand not only scientific knowledge and how it is produced, but also the contextual environment and global issues that are intertwined within the Learning Area. The Natural Science Learning Area must be able to provide a foundation on which learners can build throughout life.

The LOs and ASs enable educators to make teaching and learning relevant beyond the classroom. Planning is important as educators are shown in the document on how lesson plans are done using the LOs and ASs (DoE, 2003:60-63). DoE (2002:16-21) gives clarity on the application of LOs and ASs of NS. DoE (2002:61) indicates the core knowledge and concepts of NS as they form 70% of teaching and 30% of the learner's immediate environment. Furthermore, DoE (2002:62-75) has introduced the core knowledge and concepts of NS for teaching: 70% of teaching and 30% of local needs of learners. The lesson plan provides data (application of the LOs and ASs for teaching and learning activities) about the school and participants involved in the teaching and learning of NS. The data from the lesson plan can generate questions or identify events in the focus group. In the focus group educators in the selected school were asked to give their views based on the 3LOs and accompanying ASs and the integration within and across NS.

3.4.1 Importance of the study

DoE (2003b:9) clarifies the LOs and ASs and the integration for educators as:

Teachers, when planning assessment activities, recording learner performance and reporting on learner progress will look to the Assessment Standards for descriptions of the level at which learners should demonstrate their achievement of the various Learning Outcomes. Having selected the Learning Outcomes and when planning

teaching, learning and assessment, teachers may find that certain Assessment Standards can be grouped or **clustered** together quite naturally.

The study analysed the lesson plan based on the LOs and ASs NS. The DoE (2003b:12) asserts, “A lesson Plan is assumed to be a complete and coherent series of teaching, learning and assessment activities.” The above activities are guided by the LOs and ASs. The educators in the focus groups were asked about the LOs and ASs based on their importance in their teaching and learning activities. NS LOs and ASs embody SKAVs, which are important in teaching and learning. In addition, questions were asked about integration within NS and across other LAs. The integration within and across LAs should enhance teaching and show learners how to apply what they learn at school to their lives or their immediate environment. The questionnaire explored the core knowledge and concepts of NS and addressed the immediate environment of learners.

3.4.2 Limitations of the conceptual framework

There are limitations in the conceptual framework based on the study as educators teaching NS are included from grade 7-9. The LOs in the senior phase are the same and ASs shows an increasing competence in the application in teaching. DoE (2002:15) asserts, “The Assessment Standards are ways in which learners demonstrate the achievement of the Natural Science Learning Outcomes.” The lesson plan showed the activities that educators are designing to show the achievement of the LOs as per ASs by learners (DoE, 2002:16-21). The work schedule and learners’ books were not considered in the observation. The work schedules are provided to educators in the district. Learners’ books are not considered as learners are not applying the LOs and Ass; they are there to achieve them. The lesson plan indicates how educators are applying the LOs and ASs in their teaching and learning activities.

The lesson plan is the map for teaching. Educators in the focus group were asked to indicate their understanding of the LOs and ASs in their teaching and learning activities. The DoE (2004:9) asserts the aim of the LA as follows:

Learning Programmes must ensure that all learning outcomes and assessment standards are effectively pursued and that each learning area is allocated its prescribed time and emphasis. Learning Programmes will be based on the relationships amongst learning outcomes and assessment standards, without

compromising the integrity of Learning Areas.

The mixed methods design added depth and breadth to the study and dealt with inconsistent results from the use of the LOs and ASs from the lesson plan analysis, focus group and the questionnaire. The views of the educators were checked against the DoE policy document of NS and other LAs. The integration was based on NS within LOs and ASs and across other LAs LOs and ASs. Integration was examined to see if it really enhances the topic or the theme. The LOs and ASs gives clarity on what learners are to achieve. The purpose of NS is to produce scientifically literate learners based on the 3LOs and ASs of NS. Learners in grade 10 have a choice to follow NS related subject in the FET. The choice will be determine by the application of the 3LOs and ASs of NS from grades 4-9 (DoE, 2009).

3.4.3 The need to use conceptual framework in teaching and learning

The DoE has introduced the LAs in order to achieve the COs and DOs. In the LAs the COs and DOs are achieved through the LOs and ASs (DoE, 2002:15). DoE (nd: 5) asserts, “The performance of learners should be measured against the Assessment Standards of the Learning Outcomes in a grade.” Educators are to apply them in their teaching and learning activities based on their descriptions. Educators are to integrate within and across Las to enhance learning and to avoid overloading of concepts for designing their teaching and learning activities. DoE (nd:5) asserts, “These formal assessment task may focus on an integration of Learning Outcomes and Assessment Standards, but could, for enrichment or reinforcement purposes, be focussed on a particular Learning Outcomes and its Assessment Standard(s).” Educators applying the LOs and ASs are in a position to measure learners’ competences. The NS 3LOs and accompanying ASs can be applied in the core knowledge and concepts of NS for 70% of teaching and should allow learners to learn 30% of what they come across in their environment (DoE, 2002:7). The 30% of learners’ immediate environment will be enhanced by integration within and across LAs based on the LOs and ASs of the LAs to achieve the COs and DOs. The DOs and COs should realise the principles underpinning NCS.

3.5 Target population

The target population comprised educators teaching NS from grade 7 to 9, that is, the senior phase in the schools. At the end of senior phase learners choose subjects that comprise NS, such as life science and physical science. If the educators have not applied the LOs and ASs in their teaching and learning activities, few learners will choose NS related subjects or careers. The focus group comprised educators teaching NS from grades 7-9 in the selected schools, that is from four schools. The questionnaire was distributed to the same educators (23) who were in the focus group.

3.6 Sampling

Purposeful sampling was used to choose the educators teaching NS in the selected schools (De Vos *et al.*, 2011:173-174). A small, but carefully chosen sample can be used to represent the population. The sample reflects the characteristics of the population from which it is drawn. The educators in the school know that the DoE wants them to apply the LOs and ASs and have the policy documents (DoE, 2002a; DoE, 2002c; DoE, 2003b; DoE, 2004) in their files to assist in their preparation of the lesson plans. The policy document helps educators in the use of the LOs and ASs. The four schools used in the study allowed for an in-depth investigation and inquiry (Engel & Schutte, 2005:286-287). De Vos *et al.*, (2011:224) points out as, “A complete coverage of the total population is seldom possible, and all the members of a population of interest, for example drug abusers, parents of preschool children or child abusers, cannot be reached (Yates 2004:24).” The educators who participated in the investigation and inquiry were those teaching grade 8-12 from the four schools. The educators in the study are teaching NS and sciences related subjects as physical sciences and life sciences. The educators teaching sciences related subject were chosen as other were teaching NS in the GET band; also, to increase the number of educators in some schools. The other particular school had two educators teaching in the GET band NS. This study is a case study for particular school in Tshwane South District for four particular schools. The independent schools did not respond or did not want to participate in the study. The principals conducted mentioned that the school governing body (SGB) did not want the educators to take part in the research.

3.6.1 Quantitative and qualitative phases

The investigation in the selected schools focused on how educators applied the LOs and ASs in their teaching and learning activities. The analysis of the lesson plan indicated the schools' application of the LOs and ASs. The questionnaire indicated the demographic and biographical context of participants and the school. The inquiry was based on the policy document supplied by the DoE. Educators' explanations and views in the focus group were measured against what is in the DoE policy documents for schools. Educators' views indicated the LOs and ASs applications. The importance of the core knowledge and concepts of NS was also demonstrated in the focus group. The educators indicated if it is possible to apply the 3LOs and ASs of NS and integrate them within and across other LAs LOs and ASs (based on the core knowledge and concepts of NS).

3.7 Triangulation of the design

The integration of answering the “How many and What” and “How and Why” offers a holistic approach to the application of the LOs and ASs in planning and their importance. The triangulation allowed the researcher to obtain different views about situations in the selected schools. The research problems are the same based on the application of the NS LOs and ASs and integration within and across other LAs LOs and ASs. The aim of triangulation is to integrate the differing strengths and avoid weaknesses of a single approach (quantitative or qualitative). The basic characteristics of quantitative research include trends in data, sample size and generalization; the basic characteristics of qualitative methods include the focus on detail, small sample and depth.

Triangulation in the study provides confirmation and completeness (Creswell & Plano Clark, 2007: 62-67). Triangulation is not simply combining different data; it tries to relate the quantitative and the qualitative approach in the study to enhance validity of data. The use of triangulation in this study allowed a more complete, holistic and contextual portrayal and revealed the varied dimensions of a given school. Triangulation can minimize bias such as (Woolley, 2009:8):

- Measurement bias
- Response bias
- Sampling bias
- Procedure bias

The bias can be minimized layer upon layer (Creswell & Plano Clark, 2007:64-67). The layers are comprised by the lesson plan analysis which used a checklist, followed by the focus group and the questionnaire. Mixed methods design seeks reliability and validity of data. The data that is stable makes it easy to replicate the results as based on quantitative approach. Validity of the qualitative approach results relies on detail and in-depth understanding of the answers to research questions.

3.8 Reliability

The focus was on what is happening in public and independent schools directly regarding planning and importance of the applications of the LOs and ASs. The study investigated the application of the LOs and ASs in teaching and learning activities. The LOs and ASs will be based on the LOs and ASs of NS and other LAs LOs and ASs for application in teaching and learning activities in the selected schools. The integration within NS and across other LAs LOs and ASs was investigated based on the DoE policy documents for schools.

The analysis of the lesson plan indicated if the lesson plan was practical or easily interpreted, easy to read and clarifies the topic chosen in the selected school. The focus group indicated the understanding of the application of the NS LOs and ASs based on the core knowledge and concepts of NS, according to the ratio of 70% of teaching versus 30% of learner's immediate environment (DoE, 2002b:62-75). This will be possible if educators are basing their teaching and learning activities on the core knowledge and concepts of NS (DoE, 2002b:62-75). The core knowledge and concepts of NS will allow for the inclusion of the learners environment.

3.9 Construct validity

It is important to investigate and enquire what educators understand and what they do in their teaching and learning activities in selected schools. The lesson plan indicated the application of the LOs and ASs in the planning of the teaching and learning activities. The

lesson plan should be based on what the DoE (2003b) and DoE (2002a) stipulate on the application of the LOs and ASs. However, there were differences in the schools' background; number of learners in class and the pass rate. The focus group provided in-depth knowledge of the educators' use of the LOs and ASs in the teaching and learning activities in the selected school.

3.10 Ethics

The research request was done submitted to Tshwane South District and the said District in the Gauteng Department of Education (GDoE) (schools (De Voset *al.*, 2011:175-176). The granting of permission allowed the researcher to approach the schools in Tshwane South District (see attached approval by GDoE and Tshwane South District). The school principal was informed by submitting a copy to confirm the approval for the study and the researcher's letter to gain access to do the study at the selected school. The principal of the selected school could decide to allow the study. Similarly, the principal of the school was asked to inform the NS educators (from grade 7-9) about the study as mentioned in the approval letter from GDoE. The principal was told that the school's name and the educator's names would not be mentioned. The schools were identified as public or independent. Educators were numbered in the selected school.

3.11 Procedures of data collection and analysis

The schools were asked for the lesson plans of the first quarter of the year. Educators had already been moderated by district officials or the school management team (SMT). The GDoE has a monitoring tool to check for educators' files where the lesson plan is also monitored. In addition, the educators had finished with a theme from the four themes in the NS. If a theme was not completed, the second quarter lesson plans were viewed to ascertain the LOs and ASs application in a selected school. The focus group was held with educators teaching NS in the selected school. The focus group data were identified by coding the school as either public or independent. The questionnaire had two sections: A and B. Section A of the questionnaire was reported per school to view the context and demographics of the school using Microsoft Excel which indicated common trends in the Likert Scale answers (McMillan & Schumacher, 1997:257).

3.12 SUMMARY OF THE CHAPTER

A mixed method inquiry was used investigate the application of the learning outcomes and assessment standards in designing learning and teaching activities in selected schools in the Tshwane South District. The learning area NS LOs and ASs and the integration within NS and across LAs were explored. The triangulation of methods gave greater clarity on the application of the LOs and ASs in designing the learning and teaching activities. The LOs and ASs are to be achieved by the learners during teaching and learning activities.

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

4.1 ORIENTATION

The previous chapters dealt with the NCS challenges based on the learning area (LA) Natural Science (NS) interpretation and implementation using the three Learning Outcomes (3LOs) and accompanying Assessment Standards (ASs) for learning and teaching activities. Natural Science is one of the Learning Areas (LAs) with the LOs and ASs directed at learner-centred and process-oriented activities. The study was carried out in four Tshwane South District secondary schools and participants were educators teaching NS in the Senior Phase (grade 7 to 9 from public schools) and sciences related subjects as life sciences and physical sciences. The researcher used three instruments to gather informationschools (De Voset *al.*, 2011:176-198).

4.1.1 Data gathering

Based on the implementation and interpretation of the National Curriculum Statements (NCS) applying the Learning Outcomes (LOs) and Assessment Standards (ASs) for teaching and learning activities in schools, data was collected to establish the challenges regarding:

- The application of Learning Outcome One and accompanying Assessment Standards (LO1and ASs).
- The application of Learning Outcome two and accompanying Assessment Standards (LO2 and ASs).
- The application of Learning Outcome three and accompanying Assessment Standards (LO3 and ASs).
- The application of the Learning Outcomes of Natural Science and other learning Areas (LAs) by integrating within Natural Science and across other Learning Areas LOs and ASs.

The Department of Basic Education (DBE) claims that educators are familiar with the LOs and ASs (DBE, 2011:23). The study is based on the application of the LOs and ASs for learning and teaching activities in selected schools in Tshwane South. The 3LOs and

ASs of NS and integration for the enhancement using the LOs and ASs for NS and other Learning Areas were studied. DoE (2002: 16-21) indicates the application of the 3LOs and accompanying ASs of NS for teaching and learning activities. DoE (2002:45) points out, “By Grade 9, most learners are able to see that certain quantities are constant even when change takes place.” Grade 9 is the exiting class at the end of which learners may choose science subjects, such as life science and physical science, in the South African education system. The lesson plan was analysed for Grade 9 in the selected schools in Tshwane South District to determine if the lessons were learner-centred and process-oriented and if learning activities were visible. The focus group was used to gauge how educators were applying LOs and ASs. The questionnaire ascertained the context of the schools and educators’ perceptions to the LOs and ASs.

4.2 SECTION A: DATA OBTAINED FROM EDUCATORS TEACHING NATURAL SCIENCES

Results in this section are based on:

- Document analysis of Grade 9 lesson plan (for 3 public schools) for NS;
- Focus group interviews (23 educators from four public schools) with educators teaching NS;
- Questionnaires (23 public school educators).

The document analyses of the lesson plan were basic for activities in teaching and learning in classrooms (De Vos *et al.*, 2011:377). DoE (2003:5) asserts the importance of the lesson plan as:

A lesson plan could range in duration from a single activity to a term’s teaching, learning and assessment and, in terms of actual time, may last from a day to a week or a month. It includes HOW (i.e. teaching style, approach and methodology) teaching, learning and assessment activities are to be managed in the classroom.

The educators should be guided by the LOs and ASs for teaching and learning activities in the classrooms. Furthermore, DoE (2003:12) points out, “A Lesson Plan is assumed to be a complete and coherent series of teaching, learning and assessment. It can consist of a single activity or several activities spread over a few days or a

number of weeks.” In the planning of their teaching and learning activities educators should select the LOs and Ass and apply the LOs and ASs to the learning and teaching activities. DoE (2002:16-21) indicates how the ASs are distinguished from the LOs and are to be applied in teaching and learning activities. DoE (2002: 48-59) clarifies how the LOs and ASs should be applied in the Senior Phase (Grade 7-9) for learning and teaching NS in classrooms. The focus group provided the study with qualitative data whereby educators gave clarity on the three LOs and ASs of NS and the importance of integration for teaching and learning activities. The questionnaire provided data concerning demographic factors, attitudes and perceptions regarding NS by educators. The questionnaire used a Likertscale (De Vos et al, 2011:212) to obtain information from respondents (De Vos et al, 2011: 188 & 190).

4.2.1 Findings of document analysis, focus group interview and questionnaire

4.2.1.1 Introduction

The barometer for educators in the implementation and interpretation of the Learning Outcomes (LOs) and accompanying Assessment Standards (ASs) in their teaching and learning activities in selected schools are the document analysis based on the lesson plan, questionnaire and focus group used for data collection. The document analysis is based on the lesson plan for teaching and learning activities for learner-centred and process-oriented activities. DoE (2003:53) indicates, “In developing a lesson plan, the teacher increases the level of detail still further and decides on how to select and sequence teaching, learning and assessment activities.” Additionally, DoE (2003: 53-55) explains the planning of the lesson plan with the applications of the LOs and ASs for the learning and teaching activities. The questionnaire was used to validate the study and to determine whether the intervention of the focus group had an impact on NS educators in the selected schools.

4.2.1.2 Data gathering

Three lesson plans (Table 4.1) represent activities of the lesson plan and a check list which indicates: **Yes or No**. In the template of the lesson plan educators are requested to mark or tick the 3LOs and ASs of NS; strands (themes); process skills; LA integration with LOs and ASs; conceptual links to previous and future lesson/learning; core

knowledge, skills, values and attitudes; expanded opportunities and teacher reflection; learner and educator activities. Table 4.1 shows what educators did in their lesson plans. The ticking of the activities in the lesson plan is aimed at reducing writing and saving (Personal communication with educators). Educators are required to tick activities that should guide their teaching. However, educators are not doing what the department requires (DoE, 2003b:3). The LOs and ASs are important in order to attain the critical outcomes and developmental outcomes for learner-centred and process-oriented learning in classrooms (DoE, 2003b:5-9).

Table 4.1 Educators' planning for lesson plan in public schools

| Analysed activities | YES | NO |
|---|-----|-----------------------------|
| 1. Are lesson plans designed by the educator? | 3 | 1(Eastern Cape lesson plan) |
| 2. Are lesson plans done by supplies (Like LTSM supplies or photocopied from LTSM)? | | 3 |
| 3. Is the LA mentioned in the lesson plan? | 3 | |
| 4. Is the duration of the lesson indicated? | 3 | |
| 5. Is the theme/strand indicated in the lesson plans? | 3 | |
| 6. Are the learning outcomes (LOs) of NS indicated? | 3 | |
| 7. Are the assessment standards (ASs) of NS indicated? | 3 | |
| 8. Do the NS ASs provide clarity on the level at which the LOs are to be achieved based on the topic. | | 3 |
| 9. Are the assessment activities based on the ASs of NS? | | 3 |

Table 4.1 Educators planning for lesson plans in public

schools (cont.)

| Analysed activities | YES | NO |
|---|------------|-----------|
| 10. Is integration indicated within the NS LOs and their accompanying ASs? | | 3 |
| 11. Is integration indicated explicitly within NS (based on the LOs and ASs of NS)? | | 3 |
| 12. Is there a description of the integration across the LAs LOs and ASs explicitly mentions that shows that enhance topic in planning? | | 3 |
| 13. Are the core knowledge and concepts of NS mentioned? | | 3 |
| 14. Are the activities based on the core knowledge and concepts of NS as mentioned for Senior phase? | | 3 |
| 15. Is 70% of the teaching devoted to the core knowledge and concepts of NS shown in the lesson plans? | | 3 |
| 16. Is 30% devoted to the learner's immediate environment or what learners can apply the topic to their lives? | | 3 |

The activities from 1-7 (Table 4.1) have been ticked by educators as given in the lesson plan template. The templates of the lesson plans are supplied by the facilitator for the NS in Tshwane South District. The educators mentioned that this system makes their work easier than copying the LOs and ASs (DoE,2003:5). DoE (2003b:5) asserts as:

Teachers need to find ways of making the planning process a manageable one, so that the process of planning is facilitative rather than being a tedious task. For example, there is not much point in rewriting Learning Outcomes and Assessment Standards each time an activity is developed. Numbering the Assessment Standards and then referring to the numbered Assessment Standards may be easier.

The educators are to apply the ASs regarding NS system of ideas in classrooms. The lesson plans (Table 4.2-4.4) indicated that educators were not following the DoE directions (DOE,

2003b:5). The facilitators who design the templates for the lesson plans should consider DoE (2003b:5) requirements; this will give educators a chance to apply the LOs and ASs or the Specific Aims as per CAPS. The 3LOs and ASs are combined as Specific Aims to ensure that teaching and learning guided by the LOs and ASs is process-oriented and learner-centred. The lesson plans are from three selected schools: the schools are public school in the Tshwane South District for Grade 9 for NS (Table 4.2-4.4). The educators ticked the activities from 1-7 on the template; activities 3-4 refer to the duration of teaching and learning activities in the selected school. In the fourth school a lesson plan was not examined. The educator explained that she was teaching NS in grade 9 for the first time as follows:

“I am protecting my post to teach Natural Sciences in grade 9 since last.”

(Note: Quoted remarks was produced exactly as provided by educator and errors were not corrected)

This educator was formerly from another province (Eastern Cape) where she taught NS. The educator said that the head of department (HOD in the selected school checks educators' files once in three months and was satisfied that the lesson plan was done by the educator (field note in my diary). The above situation indicates the challenges the educators have in the application of the LOs and ASs for planning. In activity 21 (Table 4.6) problems are further explained. The activities from 8-16 (from Table 4.1) indicate the topic chosen using the NS LOs and ASs; other learning areas (LAs) learning outcomes (LOs) and assessment standards (ASs) for integration and the use of the core knowledge of NS. DoE (2003b:2) wants educators to apply the LOs and ASs to the activities, that is, to give the picture of teaching and learning activities in the classroom. The activities from 8-16 from the lesson plan should indicate the teaching and learning activities in the classroom. The educators designed the lesson plan and used the template to fill in the context, date, conceptual links, core knowledge, skills, values and attitude, expanded opportunities, teacher activities, teacher reflection, learner activities and resources or LTSMs. However, the activities from the lesson plans as indicated in Tables 4.2-4.4 were not guided by the LOs and ASs as required by the DoE (2003a:8-12; 2003a:16-21; 2003b:12-13).

The lesson plans from the three schools (Tables 4.2-4.4) indicated how the educators in the schools plan their activities in classroom. DoE (2003b:3) stressed the importance of the lesson plan; educators should realise that the lesson plan should be seen and interpreted as a teaching and learning document. The questionnaire activity 17 (Table 4.6) indicates that more than 50% of educators in the selected schools found it difficult to apply the LOs and ASs in their teaching and learning activities. The Activity 22 (Table 4.6) from the questionnaire gives clarity about the workshops or in-service training for educators. The educators used manuals provided by the department during their trainings or meetings scheduled (i.e., educators' views during focus groups). The DoE (2003b: Foreword) describes the era of educators prior to implementation of outcomes based education (OBE) in South Africa as, "They were controlled followers and were forced to practise through prescription." The meetings or in-service training are not conducted as required by the DoE/DBE. Teachers used NCS Teacher Training Manuals and educators presented the content as prescribed by those manuals (cf. findings of focus groups). The lead educators are educators chosen to conduct workshops for the implementation of the curriculum in Gauteng Province. The facilitators just move around during the training. The DBE (2011:na) prescribes that "The National Curriculum Statement for Grade R-12 builds on what the previous curriculum but also updates it and aims to provide clearer specification of what is to be taught and learnt on a term-by-term basis." The educators in the focus group responded about the CAPS as follows:

"This is going back to what we were doing use a scheme book with content given to us. No more LOs and ASs mentioned in our teachings."

"We are not going to have big files and we just copy from the document for teaching in our classrooms."

"The LOs and ASs were frustrating us and teaching was not as fun as it was in the past."

"In the CAPS we will be ticking the Specific Aims and copy from the manuals for the content."

"In the CAPS era the questions are mentioned for class activities and facilitators will find more work in learners books."

“The CAPS era has provided us with workbooks for learners to use for activities.”

(Note: Quoted remarks were produced exactly as provided by educators and errors were not corrected)

The above comments indicate that the meetings or workshops were not based on the Specific Aims as per CAPS. Educators explained how they were prepared for CAPS and the challenges encountered with the application of the LOs and ASs in the teaching and learning in classrooms. In activity 26 (Table 4.6) educators assert their feelings regarding the shift from the LOs and ASs. Educators are currently being used as a test case by the Minister to determine the effect of changes. Consequently, learners suffer as borne out by international benchmark performances. The educators are ill-prepared to apply the LOs and ASs and this also creates problems in learner performance in higher education. Learners are taught passively to absorb NS system of ideas. Table 4.2-4.4 indicates the state of lesson planning in schools. Some learning and teaching support materials (LTSMs) include lesson plans and some publishers are producing lesson plans and assessment activities for schools. The educators photocopy these activities for learners to cut and paste in their books. Thus, learners do not employ skills, knowledge, attitude and values (SKAVs); knowledge is only for examination purposes or assessment. The teaching and learning as based on the planning (Table 4.2-4.4) will not achieve what is envisaged for educators and learners according to OBE curriculum planning. The educators' responses to the LOs and ASs in the focus group interviews were as follows:

“The LOs and ASs are difficult and time consuming to copy them.”

“The district papers are not showing using them in their papers.”

“We have knowledge of them and the department has seen that it is difficult to use them and they have change them.”

“In the meetings the facilitators and lead educators they were reading the training manual and groups to answer what the teaching manuals wants us to do.”

“We follow the assessment standards like drawing the hypothesis of LO1.”

“The LOs are there to give us clarity on what to teach in class.”

“we are having problems to have the documents that have the LOs and ASs to make teaching more easier.”

(Note: Quoted remarks were produced exactly as provided by educators and errors were not corrected)

The above remarks indicate that some educators apply the LOs and ASs in their teaching and learning activities. The facilitators and lead educators should study the FET Band teacher training manual and check how this document can help them in training. The curriculum designers in the GET Band should align with the FET Band for the underlying principles of NCS as progression. The remarks indicate how the workshops or meetings are conducted contrary to practice in Britain (Sanderson, 1987:119-138). The DBE should ascertain strengths and weaknesses of schools and recall the weaknesses of the previous C2005 and NCS workshops to avoid repetition in CAPS training; less than 80 hours is used to ground the educators in the interpretation and implementation of CAPS. The following remarks indicate educators' views:

“During our meetings with facilitators they mentioned that learners should write most of the time in their books. They wanted to see information in learners books and not interested with the LOs and ASs.”

“The facilitators have make it easy for us just to tick them.”

“To use them will make teaching to take more time and lot of paper in our lessons will be used.”

(Note: Quoted remarks were produced exactly as provided by educators and errors were not corrected)

The facilitators encourage educators to give learners the products of NS. The educators do not enable learners to demonstrate and apply SKAVs in their learning, assessment and their daily lives. The type of learning based on the above remarks shows that passive learning is taking place in classrooms in the selected schools. The number of learners (Table 4.1: activity12 and activity 11 indicates the school's location) in classrooms has an influence on teaching. The DoE/DBE has mainstreamed learners with barriers and different learning styles. The educators are not applying the LOs and ASs in their teaching and learning activities. Educators and facilitators are more concerned with NS ideas or

products of NS in learners' books. The learners are the passive recipient of NS products. The lesson plans (Table 4.2-4.4) used by the educators do not accommodate diverse learning styles based on the issues to be considered for planning (DoE,2003b:5-10).

Table 4.2 Lesson planning for school A

| | |
|------------------------|--|
| Theme | Life and living |
| Topic | Reproduction and digestion |
| LOs and Ass | LO1AS3; LO2AS1(ticked) |
| Core knowledge | Thinking and reasoning about how microorganisms vary and how they help in life processes such as reproduction, respiration and digestion of food. |
| Sub-strand (ticked) | 1. Life processes and healthy living |
| Integration within NS | Not provided in the template of the lesson plan |
| Integration across | LO/AS (crossed) |
| Conceptual links | LO |
| LTSMs | Textbook |
| Teacher activities | Diseases and drugs. Micro-organisms, HIV, MDR-TB and XDR-TB. Shapes of bacteria cells (spiral, rod shape and spirillum).Grow fungi and observe how they reproduce. Observe how they reproduce. |
| Learner activities | Learners were given an activity to complete. |
| Expanded opportunities | Revision was made with all learners and the slow learners were given extra work. |

Table 4.3 Lesson planning for school B

| | |
|------------------------|--|
| Theme | Matter and Materials |
| Topic | Elements and compounds |
| LOs and ASs | LO1AS1;2 LO2AS2;3LO3AS1;2 |
| Core knowledge | Learners must be able to balance equations and know how elements react to form compounds. Classifying matter according to its properties. Explaining the formation and breakdown of compounds. |
| Sub-strand (ticked) | 1. Properties and uses of materials 2. Structure, reactions and changes of materials. |
| Integration within NS | Not provided in the template of the lesson plan |
| Integration across | Not done or crossed. |
| Conceptual links | Elements and compounds. Chemical balancing. |
| LTSMs | Not mentioned |
| Teacher activities | |
| Learner activities | Learners were given an activity to complete. |
| Expanded opportunities | Re-teaching: Learners were showed how to balance equations and naming compounds such as e.g. NaOH, CaCO, CuSO ₃). |

Table 4.4 Lesson plan for school C

| | |
|------------------------|--|
| Theme | Blood pressure and heartbeat |
| Topic | Circulatory system |
| LOs and ASs | LO1AS1,2,3; LO2AS2(ticked) |
| Core knowledge | How to measure heart rate. What blood pressure is normal? What affects BP |
| Sub-strand (ticked) | Not mentioned |
| Integration within NS | Not provided. |
| Integration across | Not provided |
| Conceptual links | Introduction to circulation. No prior knowledge. |
| LTSMs | Not mentioned. |
| Teacher activities | Explain to them the procedure to follow and hand out the worksheet. |
| Learner activities | First the learners will measure each other's heart rate. The learners will do 2minutes of timed exercise, when they are done, their pulse will be taken again. The learners will get their BP measured with a machine and write it down. |
| Expanded opportunities | N/A |

Note: The content in the planning (Table 4.2-4.4) were written as they are in educators plans from the three schools in Tshwane South District errors were not corrected.

Tables 4.2 - 4.4 from schools A, B and C indicate planning in grade 9 classrooms during teaching of the mentioned topic from the theme. The DoE (2003b:12-14) gives clarity on the process to consider for the lesson plan. DoE (2003b:21) mentions the basics of the LOs as:

The Natural Sciences Learning Outcomes speak of learners' competence in choosing relevant knowledge and skills and making choices about how to produce something which is appropriate to the situation or task they have. We see the Learning Outcome in the learners' ability to "put it all together." In this sense, the Learning Outcomes are not simple, but compound performances because they integrate several responses by the learner.

The educators ticked the 1-7 activities as in Table 4.1; activities 8-16 were not concretely done as in terms of DoE (2003b:2). The template supplied to the educators allows them to tick the LOs and ASs. The educators are not allowed to apply them to their topics. Most educators in the public schools mentioned that the workshops are conducted by fellow educators (cf. Focus groups interview). They mentioned that the facilitators merely move around and only assist the lead educators. Educators complained that the three learning outcomes (LOs) and the accompanying assessment standards (ASs) of NS are difficult to use in their teaching and learning activities. They found that most of their meetings with facilitators did not deal with the LOs and ASs (Table 4.6, activity 14-26 of Natural Sciences based on the four themes of NS). They also said that they never dealt with the core knowledge (Table 4.6 activity 24) of NS (DoE, 2003a: 62-75). The educators' lesson plans did not include core knowledge as mentioned by DoE (2003a: 62-75). The educators were amazed when reading about the importance of the core knowledge for their teaching and learning activities. DoE (2003b: 10-11) stresses the importance of the core knowledge of NS for the mentioned topics in the lesson plans. DoE (2003: 19) asserts the LOs, ASs and core knowledge of NS are "The main features of the Learning Area Statement are the Learning Outcomes, the Assessment Standards that embody the knowledge, skills, values and attitudes required to achieve the Learning Outcomes and the "statements" of Core Knowledge and Concepts."

DoE (2003b: 48-49) stresses the application of the LOs and ASs for the use of the core knowledge in their topics or themes. The above document (DoE, 2003b) was used to demonstrate the importance of the LOs and ASs for the application in the teaching and learning activities during focus groups. The educators mentioned that the LOs and ASs were not important in their teaching and learning activities. DoE (2003b: 53-55) was photocopied for the educators to peruse during focus groups. The educators mentioned that they had never considered the document as they had only been given the template of the lesson plan. The

educators were also given templates for the CAPS planning whereby they tick the Specific Aims. They do the same things as during the previous system of education. The educators use books called schemes with contents or topics with dates with CAPS. The educators mentioned that they have gone back to basics and the textbooks are most important for covering the four themes of NS. Their views are supported as DBE (2011:12) states “Every learner must have his/her own textbook. Teachers should ensure that a system is in place for recovering textbooks at the end of every year. Schools must provide secure storage space where textbooks, and other equipment, can be stored safely”. The educators also mentioned that they were told that the content is thus available and easy to teach. DBE (2011: 87) states, “The Specific Aims, the topics and content and the range of major skills must be used to inform the planning and development of assessment tasks”. The activities 8-16 (Table 4.1) should give clarity on the topic to be presented in the context of NCS using the learning outcomes and assessment standards for teaching and learning. The curriculum and assessment policy statement (CAPS) (i.e., the strengthening of the national curriculum statement) is based on the topics to be presented in classrooms.

The focus group interviews were only held with the public schools in Tshwane South District in Gauteng. The private school chosen did not respond and thus did not participate in the research. The focus group interviews was used to give clarity mostly on the activities 8-16 (Table 4.1). The activities 8-16 (Table 4.1) deal with the application of the LOs and ASs for teaching and learning activities from a topic or the sub-strand or theme. The activities from 8-16 indicate learner-centred and process-oriented teaching and learning in classrooms. The focus group explored how educators in the four selected schools understood the application of the LOs and ASs for learner-centred and process-oriented teaching and learning and also indicated teacher readiness for CAPS. The questionnaire and focus group from school A - D indicated the reason for planning: grade 9 learners should be able and know how to apply scientific tools (LO1 and accompanying ASs); the system ideas or products of NS (LO2 and accompanying ASs); and to realise that NS is a human-activity and to use different world views (LO3 and accompanying ASs) in solving problems or challenges in their assessments and lives. The LOs and ASs or the Specific Aims for CAPS should be implemented for the Senior Phase (grade 7-9) by 2014 in South African schools. The focus group was recorded and

a diary was kept for the purpose of any reactions during the focus group. The responses of the educators in the four selected schools have been quoted verbatim. The responses have been quoted based on the research questions (section 1.4).

Table 4.5 Educators' responses to questionnaire regarding biographical or background information

| | | | | | | |
|----|---|-------------------|---------------------|------------------------------|-------------------------|------------------------|
| 1 | Gender | Female | Male | | | |
| | Responses | 13 | 10 | | | |
| 2 | Ages | Incomplete years | Not completed | | | |
| | Responses | 30-49 (23) | | | | |
| 3 | Ethnicity | Black | White | Coloured | Asian/Indian | |
| | Responses | 22 | 1 | | | |
| 4 | Teaching experience | Less than a year | Between 1 & 5 years | Between 6 & 10 years | Above 11 years | |
| | Responses | | 2 | 17 | 4 | |
| 5 | Experience in NS | Less than a year | Between 1 & 5 years | Between 6 & 10 years | Above 11 years | |
| | Responses | 8 | 14 | 1 | | |
| 6 | Your highest qualifications | Grade 11 or lower | Matric (Gr 12) | Post-matric/certificate | Baccalaureate degree(s) | Post-graduate (s) |
| | Responses | | | 21 | 1 | 1 |
| 7 | Your teaching level | Post level 1 | Post level 2 | Post level 3 | Post level 4 | |
| | Responses | 22 | 1 | | | |
| 8 | Status of your post | SGB | Temporary | Permanent | | |
| | Responses | | | 23 | | |
| 9 | NS & Tec teaching qualifications | Grade 11 or lower | Matric (Gr 12) | Post Matric or certificate | Baccalaureate degree(s) | Postgraduate Degree(s) |
| | Responses | | 14 | 6 | 3 | |
| 10 | Describe your area | Urban | Rural | | | |
| | Responses | 23 | | | | |
| 11 | Status of your school | Farm school | Ex-Model C | Private school (Independent) | Location school | |
| | Responses | | | | 23 | |
| 12 | Enrolment in each NS class | Between 15 and 25 | Between 26 and 35 | Between 36 and 45 | Above 45 | |
| | Responses | | | 23 | | |
| 13 | Level of learners' backgrounds | Poor | Below average | Average | Above average | Affluent |

| | | | | | |
|------------------|---|----|--|--|--|
| Responses | 4 | 19 | | | |
|------------------|---|----|--|--|--|

Table 4.5 indicates the demography of the selected schools in Tshwane South District. There were more males than females; the ages of the educators range between 30 and 49 years. There is only one white educator in the four chosen public schools. Most educators' teaching experience is between 6 and 10 years and most attended the workshops based on the LOs and ASs organised by the district. Most educators have little experience in teaching NS in the GET Band. Most educators have less than 6 years' experience in teaching the LA, that is more than 90%. Most educators met the criteria regarding qualifications which are post grade 12. Most educators teaching NS are at post level one and one HOD is teaching NS. The leadership role for the LA is lacking based on one HOD. All the educators are permanently employed by the DoE in Gauteng Province. Most educators had a post-matric diploma or certificate for teaching NS. All the schools in the district are in the township area where there is overcrowding in classrooms. The department should consider the educator to learner ration and educator capabilities in the content in the learning areas (NS) for intervention purposes for learners with barriers (DoE, 2003b:7). Proper grounding in the application of the LOs and ASs or the Specific AIMS as in terms of CAPS will develop positive attitudes and perceptions in the teaching and learning in schools.

Table 4.6 Exploration of attitudes and perceptions regarding NS for public schools

| | Activities | | SD | D | N | A | SA |
|----|--|---|----|----|----|----|----|
| 14 | Do you teach according to NCS for the NS GET for the band? | n | 0 | 19 | 4 | 0 | 0 |
| | | % | 0 | 83 | 17 | 0 | 0 |
| 15 | Are your topics based on core knowledge, concepts and unifying statements as in the NS policy document? | n | 5 | 8 | 7 | 3 | 0 |
| | | % | 22 | 35 | 30 | 13 | 0 |
| 16 | Do the assessment standards (ASs) guide the teaching of your topics? | n | 3 | 9 | 11 | 0 | 0 |
| | | % | 13 | 39 | 48 | 0 | 0 |
| 17 | Does the NS ASs guide your assessment activities? | n | 0 | 14 | 7 | 0 | 2 |
| | | % | 0 | 61 | 30 | 0 | 9 |
| 18 | Is it possible to cover all three the LOs and the accompanying ASs of NS according to the DoE policy? | n | 0 | 14 | 6 | 0 | 3 |

| | | | | | | | |
|--|---|---|-----|----|----|----|----|
| | | % | 0 | 61 | 26 | 0 | 13 |
| 19 | Is integration within the NS LOs and the accompanying ASs possible? | n | 0 | 9 | 5 | 7 | 2 |
| | | % | 0 | 39 | 22 | 30 | 9 |
| Table 4.6 Exploration of attitudes and perceptions regarding Natural Sciences for public schools (cont.) | | | | | | | |
| 20 | Is integration across NS (that is with other LAs such as technology and mathematics) possible? | n | 0 | 10 | 3 | 0 | 10 |
| | | % | 0 | 43 | 13 | 0 | 43 |
| 21 | During in-service training sessions /workshops, the facilitators covered the LOs and ASs of NS and gave practical examples illustrating the teaching of NS using the LOs and ASs of NS. | n | 19 | 4 | 0 | 0 | 0 |
| | | % | 83 | 17 | 0 | 0 | 0 |
| | | | | | | | |
| 22 | During in-service training sessions and/workshops, the facilitators covered the integration within LOs and ASs of NS and gave practical examples. | n | 10 | 13 | 0 | 0 | 0 |
| | | % | 43 | 57 | 0 | 0 | 0 |
| 23 | During in-service training sessions and/workshops, the facilitators covered the integration across the LAs LOs and ASs pertaining to teaching NS and gave practical examples. | n | 15 | 8 | 0 | 0 | 0 |
| | | % | 65 | 35 | 0 | 0 | 0 |
| 24 | During in-service training sessions and/workshops, the facilitators provided clarity on the core knowledge and concepts of NS on the LOs and ASs of NS. | n | 23 | 0 | 0 | 0 | 0 |
| | | % | 100 | 0 | 0 | 0 | 0 |
| 25 | DBE claims that you are familiar with the LOs and ASs for teaching and learning activities. | n | 4 | 16 | 0 | 0 | 3 |
| | | % | 17 | 70 | 0 | 0 | 13 |
| 26 | You are prepared for the CAPS. | n | 0 | 0 | 6 | 4 | 13 |
| | | % | 0 | 0 | 26 | 17 | 57 |

(Note: The findings were copied from educators' questionnaires from four public schools)

(Note: The findings were copied from educators questionnaires from four particular public schools)

n= 23

100= Percentage

14-26 = Activities/Responses from the questionnaire

SCALE:

1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-strongly agree.

According to Table 4.5-4.6, 23 educators teaching NS Physical Science and Life Science were included as they were teaching Grade 8 and 9 in the selected schools. These educators mentioned that CAPS content was in the Subject Statements (DoE,2003c:16-31; DoE, 2003d:38-53). The educators who were familiar with the use of the teaching and learning activities of the two subjects (Physical and Life Sciences) were the most satisfied. The scope or the content of the two subjects is set out in the Subject Statement to make it easy for educators. The LOs and ASs are used in the scope or content of the two subjects. In the CAPS documents the Specific Aims are not presented as in the NCS. The educators who went for training and used their documents for the LOs, ASs and assessment or examination guidelines applied the LOs and ASs in their teaching and learning activities with greater ease. The educators also teach the two subjects based on what they learned in college or university. Most FET Band (Grade 10-12) educators did science in Grade 10-12 in their schooling. The educators who teach the two subjects were thus able to apply the LOs and ASs based on the science system of ideas or products. The responses were as follows:

“Base on the LOs of NS, Physical Science and Life Science and Mathematics the practical component of the work and investigative work we separate them”.

“LOs gives you expected level and what learners are able to do in Physics.”

“LO2 is knowledge and application and what learner no to require in life sciences.”

“LO is more to the real-life situation and in physics assessment it is practical like cars movement in mechanics.”

“LO2 is more of application and we get questions for 3levels for Bloom’s Taxonomy in Physics.”

“LO1 is base on typical investigation in Physics.”

“LO3 is in relation to the environment to relate what learners have learnt in LO2. This will be most realistic level in mechanisms based on cars.”

“Integration aligns the subject you talk. Example doing life and dead it is whereby Physics and Life integrate.”

“Use concepts of lightning in Earth and Beyond and electrostatic in Physical Science.”

“Ratios and stoichiometric links with maths. To teach physics you need to have small background of Maths.”

(Note: Quoted remarks were produced exactly as provided by educators and errors were not corrected)

Educators also attended CAPS meetings for Grade 10 if allowed by the principals. The manuals used for the two subjects are not the same as the once used for the GET (Grade 7-9) (cf. NCS Teacher Training Manuals 2006: Physical/Life Sciences). The educators teaching Physical and Life Sciences are given assessment guidelines for their subjects in Grade 10-12.

Table 4.5, response 5 indicates that most educators have less than six (6) years' experience in teaching NS. What is more, responses for 6 and 9 indicate the planning of the lesson plan. The educators encounter problems using the NS policy documents (DoE, 2002c; DoE, 2003b). Furthermore, Table 4.6 (responses 14-17) confirms the challenges in the implementation and interpretation of the LOs and ASs for teaching and learning activities (DoE, 2003b:2 &4). In the focus group more clarity was given on what educators thought about the LOs and ASs in their teaching and learning activities. The focus group interviews of the four selected schools were transcribed verbatim and a diary was kept to record emotionality, facial and body gestures. The responses for the focus group indicated the challenges educators are facing in the use of the LOs and ASs for learner-centred and process-oriented teaching and learning activities. Table 4.6 (responses 21-24) indicates the challenges that the educators faced during the in-service training sessions. The training as organised for the implementation of the LOs and ASs should have been done as per activity 25 and this created the situation whereby educators in the focus groups were happy about the CAPS content and assessment. The

LOs and ASs or the Specific Aims provide for learner-centred and process oriented teaching and learning (DoE, 2003a; DBE, 2011). DoE (2003a:4-15) indicates the NS teaching and learning activities for classrooms and the core knowledge to make NS learning and teaching relevant in classrooms (DoE, 62-73). CAPS has provided the content to be taught on a term-term basis; the educators should use their SKAVs of the previous LOs, ASs, themes and core knowledge for strengthening their teaching and learning activities in classrooms from the provided content.

4.3 SUMMARY

The educators have not studied the documents dealing with the LOs and ASs or the Specific Aims. The facilitators and lead educators should consider the FET Band teaching manuals which can equip them as OBE curriculum specialists. Lack of familiarity with the departmental policy documents has created problems for the educators in applying the LOs and ASs. The educators should read the relevant documents dealing with the curriculum to develop learners as envisaged. The LOs and ASs are learner-centred and process-oriented to ensure that learners are holistically developed according to the underlying principles of NCS.

CHAPTER 5

OVERVIEW OF THE STUDY AND RECOMMENDATIONS

5.1 INTRODUCTION

In addressing the aim of the study, chapter two was an attempt to provide clarity on application of the learning outcomes (LOs) and assessment standards (ASs) with regard to the teaching and learning in the learning area (LA) natural sciences (NS) as stipulated by the DoE (2003a; 2003b) for learner-centred and process-oriented teaching and learning activities. The challenges educators experience as a result of the training or professional development by the Department of Education (DoE) has an impact on the application of the LOs and ASs to teaching and learning in schools. The educators should read and use the policy documents (DoE,2003a; DoE,2003b) to be able to apply the LOs and ASs of the LAs. The DoE and the DBE both promote process-oriented and learner-centred teaching and learning. Effective learning and teaching in our country depends on the holistic development of teachers. The DoE and the DBE have made unprecedented changes to address the persistently low performance of schools in order to improve education. The aims of C2005, NCS/RNCS and CAPS were to better the performance of learners. In 2009, the Minister of Basic Education established a ministerial committee to undertake a review of the NCS/RNCS and the committee produced the Curriculum and Assessment Policy Statements (CAPS). The DBE acknowledges that CAPS is not the solution to the implementation and interpretation of the curriculum.

The DBE sees CAPS as the strengthening of the NCS/RNCS for teaching and learning. Furthermore, teacher development remains a challenge in public schools. In July 2009, the Teacher Development Summit was held with all the stakeholders in the education sector such as the teacher unions, the Education Labour Relations Council (ELRC) and SACE (DBE, 2011d:4). The independent examination board (IEB) was concerned about the

inadequate level of knowledge of the educators who were facilitating the NCS/RNCS workshops or meetings for the NCS/RNCS. The national department's plans for education are difficult to implement as the educators need to be empowered to be able to understand and practise NCS/CAPS in their teaching and learning in classrooms. The DBE has introduced CAPS documents for each subject to replace the Subject Statements, Learning Programme guidelines and Subject Assessment Guidelines for Grades R to 12, instead of enhancing them (DBE, 2011:3). The DBE (2011c:4) points out, "The National Curriculum Statement Grades R-12 gives expression to the knowledge, skills and values worth learning in South African schools." The LOs and ASs were developed for learning and assessment in the classrooms, however, the content was not clearly specified as in the FET Band for the sciences in terms of physical sciences and life sciences. DoE (2003a:18-33) stipulates content and context by applying the LOs and ASs. Consequently, the context was specified by the core knowledge (DoE, 62-75) for the appropriation for what learners encounter; however, this is missing in the CAPS documents. The DBE (2011) should have considered section 2.4 (chapter 2) for the implementation and interpretation of the Specific Aims in terms of CAPS. The three LOs and ASs are the vehicles to implement the specific aims in terms of CAPS.

DoE (2003a:17) indicates the originality of the three LOs and the accompanying ASs for learning and teaching activities for CAPS (DBE, 2011:13-84) as well as the content and concepts to be learnt on a term-to-term basis. The specific aims of CAPS are not clear with regard to what is to be done regarding specific content and concepts. The DBE claims that educators' familiarity with the LOs will bring about effective teaching and learning in classrooms. The three LOs of NS emphasise the involvement of learners in all the investigations, the importance of the ability to apply and use the NS products or system of ideas and an understanding of science as a human activity (DoE, 2003:25-29). The DoE (2003:23-24) could enhance the DBE (2011:13-84) as teachers have to expand their knowledge with regard to the teaching of the concepts and contents for NS. This section is a repetition of what you have already discussed. The transition from the LOs to the Specific Aims would be easier if educators use the two concurrently for teaching and learning in classrooms. The comprehension of the ASs will enhance the Specific Aims based on the

mentioned topics, content and concepts which were listed in terms of CAPS. Notwithstanding, the CAPS specific aims are based on the possibility ('should') and the LOs are based on the means ('being able to do'). The educators should be able to use the LOs and ASs with the CAPS content and concepts to develop learners' scientific literacy. Familiarity with the ASs can enhance the teaching and learning of the topics, content and concepts of NS in the classrooms. The ASs is concerned with the skills, knowledge, attitudes and values (SKAVs) which encompasses achievement that is visible (DoE, 2012). The LOs and specific aims are a good starting point to familiarise learners with the four themes of NS in order for teaching and learning activities to have an impact on the lives of learners and to develop scientifically literate learners. The specific aims and LOs of NS can raise the awareness of educators concerning the role of NS as part of the curriculum and its impact for learning and teaching in schools. Learners acquire NS products by the doing of science (process skills), and understanding science (using different world views to understand how human activity developed NS). "Achievement is evident when the learner can demonstrate" as succinctly put by DoE (200a:26).

The DBE (2011) documents for the subjects such as NS present three specific aims with the topics, content, concepts and the assessment activities. The concepts had no level descriptors to guide as in the NCS (DoE, nd: 4). The NCS had illustrative levels for learners guided by the assessment standards (ASs) for learners to achieve the LOs. The DBE should have strengthened the NCS by using these terms and those topics, content and concepts as guided by the ASs. The NCS content was not clarified in terms of CAPS; the latter uses different terminology to what has been used with the LOs for Specific Aims. The DBE should include the core knowledge to guide contexts for teaching and learning NS. The in-service training in Gauteng was done by fellow educators called lead educators. The DBE should have organised workshops to deal with the NCS and indicated clearly how CAPS was to be strengthened. The curriculum change is referred to in section 2.2 by Pretorius (2008:2) who interviewed the former Minister of Education, Sibusiso Bengu. Furthermore, Musker (1997:3) asserts the changes in education were basically politically motivated (see section 2.2). As this is the final chapter, the purpose is to provide an overview of the study as well as a brief review of the rationale for the study, the problem statement, the research design

and research methods. After this, a summary of the main findings and conclusions is given, followed by appropriate recommendations.

5.2 A BRIEF REVIEW OF THE RESEARCH QUESTIONS AND AIMS AND RESEARCH METHODS

In this section, the orientation, problem statement, research questions and aims, research strategy and research methods set out in chapter one are revisited to determine to what extent the aims of the research have been achieved

5.2.1 Orientation and problem statement

The South African education system is in a transitional phase with regard to addressing equity and redress issues in the curriculum. The education system is based on outcomes based education (OBE) principles and the respective curriculum changes are known as Curriculum 2005 (C2005), the National Curriculum Statements (NCS) and the most recent change is called the Curriculum and Assessment Policy (CAPS). The three curriculum changes should be implemented through the learning areas (LAs) or subjects based on the specific outcomes (SOs) and learning outcomes (LOs). The CAPS changes are based on the specific aims (SAs) and the content given for what is to be done on a term by term basis. The specific outcomes were strengthened in the LOs because of the training and the language that was used for delivery for C2005. The LOs and ASs are used in teaching and learning where educators act as facilitators; while the learners are the active participants with regard to their own learning processes and have to apply what they learn to what they come across in their environments. The DoE (2003a; 2003b) explains that the LOs and ASs should help achieve the following vision for South Africa: “a prosperous, truly united, democratic and internationally competitive country with literate, creative and critical citizens leading productive, self-fulfilled lives in a country free of violence, discrimination and prejudice” (DoE, 1997:1).

However, the international benchmark performance of our learners leaves much to be desired; consequently, in an attempt to address this problem, a number of significant changes have been made to the various curricula in South Africa. The different education ministries made certain changes that must be interpreted against the backdrop of the prevalent political

climate. The facilitators and leading educators concerned with the training or the development of other educators also had an influence on the interpretation and implementation of the curriculum. Another problem was that the educators did not read or understand the policy documents sent to schools. Educators are given the NCS policy document that have been developed to assist them in their teaching and learning activities in classrooms. Policy documents such as the DoE (2003b:1) provide the following information:

The purpose of these guidelines are to guide teachers in the development of a Learning programme by:

- providing guidelines to teachers on how to develop a Learning Programme;
- providing the essential features and underlying principles of a Learning Programme;
- promoting and encouraging adherence to the RNCS and support for its implementation; and
- providing a framework for teacher development and training.

The policy documents supplied by the DoE are underpinned by visionary and developmental ideas with regard to the application of the LOs and ASs. The aim of LOs and ASs are to achieve the critical and developmental outcomes, which underlie the development of the curriculum in South Africa. The use of policy documents with regard to the three curricula changes, namely C2005, the NCS and CAPS, should be read by educators so that they can achieve clarity with regard to implementing learner-centred and process-oriented teaching and learning.

5.2.2 Research questions and aims

The aim of the study was to study how educators in particular schools in the Tshwane South district interpret and implement the learning outcomes (LOs) and assessment standards (ASs) in their teaching and learning activities. DoE (2003a:7) points out the importance of the LOs for learners as:

The three Learning Outcomes address different competencies and ideally should not overlap, so as to avoid being confused during assessment. However, they do

come together when extended tasks are designed for learners, and it is normal for two or three of the Learning Outcomes to be seen in the same extended task.

The ASs should make it possible for learners to achieve the LOs in order for them to achieve the critical outcomes (DBE,2011a:5; DoE,2003a:1) and developmental outcomes (DoE,2003a:1-2). The critical outcomes (COs) and developmental outcomes (DOs) will make it easy to achieve the principles that underpin the current education system (see section 2.2). The study was based on the following as:

- Are educators designing teaching and learning activities from the 3LOs and the accompanying ASs of NS?
- Are educators integrating within NS and across the other LAs LOs and accompanying ASs in their teaching and learning activities?

The study aim was in order to achieve or address the above; the main aim will be as follows:

- To explore if educators interpret and implement NS in their teaching and learners activities in accordance with the specifications of the LOs and accompanying ASs.

The above aim is intended to facilitate the application of the Specific Aims in terms of CAPS. This should assist educators in comprehending the ASs, facilitate their teaching of content by using the concepts specified in terms of CAPS (DBE, 2011) and familiarise them with the content and concepts of NS. The ASs are the barometer that describe what learners must know and comprehend with regard to NS products or system of ideas. The ASs from the 3LOs of NS concretely clarifies what should be mastered by learners in terms of skills (LO1/Specific Aim 1), knowledge (LO2/Specific Aim 2) and attitudes and values (LO3/Specific Aim 3) of NS. Hence, the learners should be guided by the Specific Aims in terms of CAPS (see section 1.1).

5.2.3 Research methodology and design

This study sought to determine educators' understanding of CAPS specific aims (SAs) that should be further enhanced by the interpretation of the specific outcomes for learning and teaching activities set out in C2005 as well as the LOs set out in the NCS. The challenges associated with in-service training or workshops for educators were also studied

regarding classroom activities as guided by the LOs and ASs. Three data collection methods were used to obtain a clear picture of how and to what extent the LOs and ASs were applied in the teaching and learning activities of the selected schools. These were document analysis of the lesson plans, focus group interviews and questionnaires that were aimed to elicit the perceptions of the challenges that educators faced with regard to the interpretation and implementation of the curriculum (NCS) in schools. The document analysis entailed the lesson plans provided by the schools; the focus group discussions involved educators teaching NS in their respective schools. Questionnaires were administered to validate whether the focus group discussions had an impact on the use of the LOs and ASs in teaching and learning. To sum up, the three instruments were used to obtain greater clarity on what was happening in schools in terms of the implementation of the curriculum and how the curriculum impacted on teaching and learning in schools.

5.3 SUMMARY OF FINDINGS

The application of the LOs and ASs promote learner-centred and process-oriented learning and teaching. The Department of Basic Education (DBE) claims that educators are familiar with the LOs and ASs with regard to their teaching and learning (DBE,2011). The three lesson plans from the selected schools provided further insight into the challenges associated with the application of the LOs and ASs to teaching and learning. The Gauteng Education Department developed strategies to intervene with regard to the LOs and ASs in terms of lesson plans and assessment activities for languages and mathematics. The strategy is called the Gauteng Primary Literacy and Mathematics (GPLMS) initiative for those schools in the fifteen districts in the Gauteng Province. The MEC, Barbara Crecy, developed the GPLMS initiative so that Gauteng schools do not have to draw up their own lesson plans and assessment activities. The GPLMS were developed to lessen teacher workload according to the MEC of the Gauteng Education Province and the Head of Department, Mr Boy Ngobeni in 2012. However, the GPLMS lesson plans do not show how the content and concepts address the LOs and ASs for is done in mathematics and languages.

The teachers' lesson plans were analysed to determine if the educators were applying the LOs and ASs in their planning of the learning and teaching activities. It was subsequently found that the analysed lesson plans were not guided by the LOs and ASs

as stipulated in the DoE (2003b:53) that states that the application of the LOs and ASs should be done with regard to learner-centred and process-oriented teaching. During the focus group interviews, the educators indicated challenges with regard to the application of the LOs and ASs and CAPS. The focus group interviews and the lesson plans indicated that the guidance provided by the department is insufficient to enhance teaching and learning in terms of the application of the LOs and ASs. Furthermore, the findings from the questionnaire showed what was happening in the workshops or meetings with regard to implementing and interpreting the LOs and ASs set out in the curriculum. Moreover, educators did not comprehend the documents on the LOs and ASs (DoE, 2003a; DoE 2003b) supplied to schools that had to be applied in teaching and learning activities. The educators' readiness for CAPS was inadequate and they were unhappy about an increased workload.

The CAPS specific aims to promote learning and teaching are not guided in the same way as the LOs and ASs for the FET Band. The educators are only provided with the teaching content, concepts and how to assess the learners (DBE, 2011). The learners are not considered in the CAPS as is the case with the application of the LOs and ASs. The Minister of Education points out, "The National Curriculum Statement for Grades R-12 builds on the previous curriculum but also updates it and aims to provide clearer specifications of what is to be taught and learnt on a term-by-term basis" (DBE, 2011). Although CAPS has a description of the ASs, educators who participated in the interviews did not appear interested in using LOs and ASs. DBE (2011:5) points out what it envisages for learners at the end of the learning process; however, the learners are not given clarity on how they will master the content mentioned each term.

5.4 CONCLUSIONS

As a result of the challenges associated with the application of the LOs and ASs to teaching and learning, scientifically literate learners have not been developed as envisaged. This can be seen in the performance in international benchmarks such as the TIMSS study (House, 2002: 275-286). DBE (2011d: 3) asserts, "Persistently low performance in the academic achievement of learners has forced government to undertake a number of unprecedented initiatives in order to improve the quality of schooling." The findings of this study suggest

that educators were challenged to achieve the curriculum aims as stated by DoE (2002a:1) as “The curriculum aims to develop the full potential of each learner as a citizen of a democratic South Africa.” Likewise, DoE (2002a:2) points out, “Assessment Standards are defined for each grade and describe the depth and breadth of what learners should know and be able to do.” Notwithstanding, the majority of educators who participated in this study did not realise that transformation in teaching and learning depends on guidance provided by the LOs and ASs. DoE (2011c: 8) mentioned, “These three aims are aligned to the three Learning Outcomes with which teachers are familiar.” However, the DBE (2011) documents do not mention the alignment of specific aims to learning outcomes in the final draft for NS.

5.4 RECOMMENDATIONS

A number of recommendations have been made with regard to improving the status quo. Since 1994, educators have been struggling to translate theory into practice. The three lesson plans (Table 4.1 and Tables 4.2-4.4) should direct educators regarding their teaching, learning and assessment activities guided by the LOs and ASs. The DoE (2003b:12-13) emphasises the following with regard to lesson plans:

- The development of teaching, learning and assessment activities;
- Identification of the role of outcomes and concepts from other Learning Areas;
- Selection of assessment strategies and selection or development of instruments to be used;
- Setting up support mechanisms for learners who experience barriers to learning.

For this reason, DoE (nd:4) identifies the LOs and ASs as “the Assessment Standards are statements that break the Learning Outcomes down into more detail and they describe criteria by which to judge how well learners are able to achieve the Natural Sciences Learning Outcomes.” Understanding of the LOs and ASs will make it easy for educators to implement the Specific Aims in terms of CAPS by 2014 in the Senior Phase (grades 7-9). The strengthening of the NCS in terms of CAPS should be guided by familiarity of the ASs. As a result, the Specific Aims are the same as the LOs. The ASs as specified will make it easy for educators to work on the content and concepts in terms of CAPS (DBE, 2011a).

5.4.2.1 Recommendations for Learning Outcome 1 of NS

DoE (2003a:6) indicates that learners should apply scientific, technological and environmental knowledge for clearly defined problems. Similarly, the DBE (2011:10) indicates that learners should use different tools to solve problems in NS. The on going implementation of the two (LO1 and Specific Aim 1) will make teaching of the allocated topics, content and concepts learner-centred and process-oriented. The DoE (2003a:16-17) describes the achievement of LO1 as specified without reference to the content and concepts of NS. As a result, the DBE (2011:3-15) indicates the content and concepts for the senior phase (grade 7-9) on a term to term basis. The educators' familiarity with the assessment standards (ASs) used to assess the learning outcomes should enable them to teach and learners to achieve Specific Aim 1.

The application of LO1 of NS for Specific Aim 1 for CAPS will make it easy for learners to do science for the topics and concepts mentioned. The DBE (2011a:10-12) points out the scientific process, definitions of skills and process skills in the same way in the NCS and CAPS. In particular, section 2.7.1 gives guidelines of the process skills in terms of the ASs. Therefore, DBE (2011a:10-12) and DoE (2003a:13-14) identify the processes for specific aim 1 and LO1 respectively. Moreover, DoE (2003a:13) stipulates the different skills to be acquired: basic, integrated and investigative process skills (section 2.7.1). The DBE should have done the same with LO1 of NS (cf. DoE, 2002a:16-17) for specific aim 1 in terms of SAPS. The educators and DBE should use the DoE (2002a:16-17) for the application of specific aim.

5.4.2.2 Recommendation for Specific Aim 2 based on Learning Outcome 2

DoE (2002a:9) points out, "The learner's competence in this Learning Outcome can be seen in the ability to collect or extract information from various sources, and then to organise and analyse that information." The assessment standards for learning outcomes 2 will make it easy for educators to achieve Specific Aim 2 of NS because it relates to the products or system of ideas on NS. Furthermore, DoE (2002a:9) maintains, "The

learners sees the usefulness of concepts which explain a range of phenomena and link a range of ideas.” For this reason, DBE (2011:10) describes Specific Aim 2 as “The main task of teaching is to build a framework of knowledge for learners and to help them make connections between the ideas and concepts in their minds-this is different to learners just knowing facts.” The DoE (2002a:18-19) clarifies the ASs for the achievement of the LOs to make it easy for the achievement of Specific Aim 2 of NS, such as recalling, categorising, interpreting and applying the system of ideas or products of NS or contents and concepts in terms of CAPS (2011a:13-84). The DBE should have given greater clarity regarding Specific Aim 2 as LO2 of NS was clearly described in previous documents (see section 2.7.2; DoE, 2003a:48-59). In this regard, clarity is required for Specific Aim 2 and the assessment standards of learning required for NS (DoE, 2003a:18-19; section 2.7.2 and 2.7.3).

5.4.2.3 Recommendation based on Learning Outcome 3

Learning outcome 3 is concerned with the following goal: “Education should help people to become problem solvers” (DoE, 2003a:10). The learners should be developed so that they are able to use different world-views, such as represented in modern science and indigenous knowledge system (IKS). The ASs for LO3 of NS should guide the educators in determining if learners are able to solve problems and if they have achieved scientific literacy against the background of cultural diversity. LO3 will enhance learners’ use of different knowledge system based on the products or system of ideas. The educators should use the RNCS/NCS and CAPS documents concurrently for teaching and learning activities in schools.

5.4.2.4 Recommendation for integration

Integration within NS and across all subjects is basic for effective teaching and learning. The DBE should introduce the purpose of integration to educators so that they understand that integration strengthens skills (Specific Aim 1 for the doing NS); knowledge (Specific Aim 2 for the topics, content and concepts of NS); and attitudes and values (Specific Aim 3 for different world views and to realise that NS is a human activity). Thus, educators become aware that learners will encounter what they have learned in NS in other subjects as well. This will lead to the mastery of skills, knowledge, attitudes and values (SKAVs) across the curriculum (DoE, 2003a). Educators should be made aware that that integration allows

learners to reflect on the relevance of knowledge acquired at school to the world outside the classroom. Therefore, integration will enhance teaching and learning activities and facilitate the application of theory in practice.

5.5 CONCLUSION

Familiarity with the LOs and the accompanying ASs assist educators in applying the specific aims of CAPS. LO1 calls for problem-solving of closely defined activities and Specific Aim 1 is connected with the science LA. Teaching and learning science entails concrete concepts using the basic processes of NS, such as using the five senses. Understanding and applying the concepts of NS will entail familiarity with LO2 (the usefulness of concepts in the content and the topics in terms of CAPS; Specific Aim 2). LO3 of NS calls for learners to solve problems in context. Specific Aim 3 and LO3 are aimed at helping learners to deal with and understand abstract concepts during learning (see section 2.7.2 and 2.7.3). The strengthening of NCS in terms of CAPS should be achieved by integrating the ASs and processes in the contents and concepts of teaching and in learning activities. The assessment activities can be comprehended more easily in terms of the ASs based on the contents and concepts for CAPS. The LOs and specific aims are the same as in DBE (2011a:10) and DoE (2003a:6). The familiarity of LO1 (specific aim 1) calls for “problem solving of closely-defined problems, Learning Outcome 3 (specific aim 3) calls for the learner to become a scientific problem solver in the context of South African society” (DoE, 2003a:10). Furthermore, the DoE (2003a:10) explains, “The learner is building a framework of knowledge by using science concepts repeatedly in a widening range of situations” (DoE, 2003a; DBE, 2011a). Furthermore, the learner sees the usefulness of concepts, which explain a range of phenomena and link a range of ideas. This study can make it easy for educators to interpret the specific aims for CAPS; the ASs of NS facilitate educators’ achievement of the underlying principles of the curriculum (DBE, 2011a:4-5; 8-9; DoE, 2003a:1-2). The DBE should encourage the facilitators to alert educators to the use of the RNCS and NCS documents for schools to render their teaching and learning relevant. The DBE should also check the documents for General Education and Training (GET) and the Further Education and Training (FET) for quality assurance. This will also indicate differences in how the contents and concepts are presented in the different bands (GET and FET) in education.

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APPENDICES

24 WISANI STREET

LOTUS GARDENS

0008

4 AUGUST 2012

THE PRINCIPAL

REQUEST FOR RESEARCH AUTHORITY

TOPIC: CHALLENGES IN TEACHING NATURAL SCIENCE IN THE CONTEXT OF NATIONAL CURRICULUM STATEMENT.

I am asking for permission to conduct a research in your school. The attached letter serves as the approval by the Gauteng Department of Education. I am a registered Masters in Natural Science Education at UNISA, who is conducting an important research in connection with the interpretation and implementation of the application of the LOs and ASs in planning. The study is based on six secondary in Tshwane South District. The results of the study will be collected by using Observation list for the Lesson Plan based on the theme from Natural Science, Focus Group with NS educators in the Senior Phase and Questionnaire. The Lesson plan is for grade 9 only and a single theme will be used, for term one only.

The results of the study will be reported anonymously, and kept confidential. The names of the participants will not be identified. If you want, I will give you feedback on the study.

Your co-operation will be appreciated.

Yours faithfully

Joseph NkosanaChitjaMnguni



education
Department: Education
GAUTENG PROVINCE

For administrative use:
Reference no. D2012/33

GDE RESEARCH APPROVAL LETTER

| | |
|-----------------------------|--|
| Date: | 4 April 2011 |
| Name of Researcher: | Mnguni J.N.C. |
| Address of Researcher: | 24 Wisawi Street |
| | Lotus Gardens |
| | Pretoria |
| | 0008 |
| Telephone Number: | 082 955 9354 |
| Fax Number: | n/a |
| Email address: | josephmnguni@yahoo.com.za |
| Research Topic: | Challenges in teaching Natural Science in the context of National Curriculum Statement |
| Number and type of schools: | SIX Secondary Schools |
| District/s/HO | Tshwane South |

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.

1

Making education a societal priority

Office of the Director: Knowledge Management and Research

9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 365 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

4. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards



Shadrack Phela MIRMSA
[Member of the Institute of Risk Management South Africa]
CHIEF EDUCATION SPECIALIST: RESEARCH COORDINATION

4 April 2011

Office of the Director: Knowledge Management and Research

9th Floor, 111 Commissioner Street, Johannesburg, 2001
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24 Wisani Street

Lotus Gardens

0008

6 September 2012

ENQ: josephmquni@yahoo.com.za

082 9559 354

Dear Sir/Madame

REQUEST THAT YOU COMPLETE THE QUESTIONNAIRE

I, Joseph NkosanaChitjaMnguni am undertaking a study to determine how and to what extent you are interpreting and implementing the National Curriculum Statement (NCS) and whether preference is given to the learning outcomes(LOs) and assessment standards (ASs) in your teaching. For this purpose, I kindly request that you complete the following questionnaire regarding the teaching and learning of NCS in terms of the learning area (LA) of Natural Science (NS). The questionnaire should not take up your teaching time. Although your response is of utmost importance for my study towards a masters degree in NS education, your participation in this study is entirely voluntary.

Please do not enter your name or contact details on the questionnaire as it has to remain anonymous. I would like to reassure you that the information provided by you will remain confidential and will be reported in summary format only.

Kindly return the completed questionnaire to me between 18 and 20 August 2010 using the envelope provided. Should you have any queries or comments regarding the study, you are welcome to contact me telephonically or through the e-mail address.

Yours sincerely

J.N.C MNGUNI

(EDUCATOR AND STUDENT AT UNISA REGISTERED FOR A MASTERS DEGREE IN NS EDUCATION)

QUESTIONNAIRE FOR NS EDUCATORS IN THE SCHOOL

N.B! THE OBJECTIVE OF THE QUESTIONNAIRE IS TO CONSOLIDATE THE INFORMATION OBTAINED FROM THE LESSON PLANS, OBSERVATIONS AND FOCUS GROUPS.

ANSWER THE FOLLOWING QUESTIONS BY DRAWING A CROSS (X) IN THE RELEVANT BLOCK OR WRITING YOUR ANSWERS IN THE SPACES PROVIDED.

EXAMPLE of how to complete this questionnaire:

Your gender?

If you are a female you will indicate this as follows:

| | |
|--------|----|
| Female | 1X |
| Male | 2 |

SECTION A

BACKGROUND INFORMATION

This section of the questionnaire is concerned with the background or biographical information. Although I am aware of the sensitivity of the questions in this section, the information will allow me to compare different groups of respondents. Once again, I assure you that your response will remain anonymous. Your co-operation is greatly appreciated.

1. Gender

| | |
|--------|---|
| Female | 1 |
| Male | 2 |

2. Age (in complete years)

| | |
|--|--|
| | |
|--|--|

3. Ethnicity

| | |
|-----------------|---|
| Black | 1 |
| White | 2 |
| Coloured | 3 |
| Indian or Asian | 4 |

4. Teaching experience in the system.

| | |
|-------------------------|---|
| Less than a year. | 1 |
| Between 1 and 5 years. | 2 |
| Between 6 and 10 years. | 3 |
| Above 11 years. | 4 |

5. Experience in teaching Natural Science (NS).

| | |
|-------------------------|---|
| Less than a year. | 1 |
| Between 1 and 5 years. | 2 |
| Between 6 and 10 years. | 3 |
| Above 11 years. | 4 |

6. Your highest qualifications

| | |
|-------------------------------------|---|
| Grade 11 or lower (std 9 or lower). | 1 |
| Grade 12 (matric, std 10). | 2 |
| Post-matric diploma or certificate. | 3 |
| Baccalaureate degree(s). | 4 |
| Post-graduate degree(s). | 5 |

7. Your teaching level at school

| | |
|---------------|---|
| Post level 1. | 1 |
| Post level 2. | 2 |
| Post level 3. | 3 |
| Post level 4. | 4 |

8. What is the status of your post?

| | |
|-----------|---|
| SGB POST | 1 |
| Temporary | 2 |
| Permanent | 3 |

9. What are your qualifications for teaching NS?

| | |
|-------------------------------------|---|
| Grade 11 or lower (std 9 or lower). | 1 |
| Grade 12 (matric, std 10). | 2 |
| Post-matric diploma or certificate. | 3 |
| Baccalaureate degree(s). | 4 |
| Postgraduate degree(s.) | 5 |

10. How would you describe the area in which you are teaching?

| | |
|--------|---|
| Urban. | 1 |
| Rural. | 2 |

11. What is the status of your school?

| | |
|-----------------------|---|
| Farm school. | 1 |
| Model C (ex-model C.) | 2 |
| Private school. | 3 |
| Location school. | 4 |

12. Number of learners in each class that you teach NS?

| | |
|--------------------|---|
| Between 15 and 25. | 1 |
| Between 26 and 35. | 2 |
| Between 36 and 45. | 3 |
| Above 46. | 4 |

13. How would you describe the economic level of the learners' backgrounds?

| | |
|---------------|---|
| Poor | 1 |
| Below average | 2 |
| Average | 3 |
| Above average | 4 |
| Affluent | 5 |

14. The ethnicity of learners in your class from the least to the most in the grade

(Write the numbers of learners)

| | |
|-----------------|--|
| Black | |
| White | |
| Coloured | |
| Indian or Asian | |

SECTION B

THIS SECTION EXPLORES YOUR ATTITUDES AND PERCEPTIONS REGARDING NATURAL SCIENCE

To what extent do you agree with each of the following statements? Please indicate your answer by using the following 5-point scale where:

1. = Strongly disagree (SD)

2. = Disagree (D)

3. = Neutral (N)

4. = Agree (A)

5. = Strongly Agree (SA)

| | SD | D | N | A | SA |
|--|----|---|---|---|----|
| 15. Your teaching is carried out according to the stipulations of the NCS for the NS LA for the GET Band. | | | | | |
| 16. Your topics in NS are based on the core knowledge, concepts and unifying statements set out in the NS policy document. | | | | | |
| 17. The assessment standards guide the teaching of your topics. | | | | | |
| 18. The NS assessment standards guide your assessment activities. | | | | | |
| 19. The DoE policy expects you to cover all three LOs and the ASs NS. This is normally possible. | | | | | |
| 20. Integration within NS LOs and their accompanying ASs is possible. | | | | | |
| 21. Integration across NS (that is with other LAs such as technology and mathematics) is possible. | | | | | |
| 22. During in-service training sessions and /or workshops, the facilitators covered the LOs and ASs of NS and gave practical examples illustrating the teaching of NS using the LOs and ASs of NS. | | | | | |

| | | | | | |
|--|--|--|--|--|--|
| 23. During in-service training sessions and /or workshops, the facilitators covered the integration within LOs and ASs of NS and gave practical examples. | | | | | |
| 24. During in-service training sessions and /or workshops, the facilitators covered the integration across the LAs, LOs and ASs pertaining to teaching NS and gave practical examples. | | | | | |
| 25. During in-service training sessions and /or workshops, the facilitators provided clarity on the core knowledge and concepts of NSbased on the LOs and ASs of NS. | | | | | |

FOCUS GROUP QUESTIONNAIRE

SECTION A

N.B! Learning outcome 1 (LO1) and its accompanying ASs involve the process skills of NS based on basic process skills such as observing, integrated process skills such as predicting and investigative process skills.

1.1 What is the importance of LO1 and its accompanying ASs in your teaching?

N.B! LO2 of NS is concerned with scientific knowledge based on the products/system of ideas of NS underpinned by certain theoretical beliefs and assumptions.

2.1 What is the importance of LO2 of NS and its accompanying ASs in your teaching?

N.B! LO3 of NS entails that teaching in NS should make learners realise that NS is a humanactivity and should also enable them to use the two world-views.

3.1. What is the importance of LO3 and its accompanying ASs of NS in your teaching?

N.B! Integration can be within NS LOs and their accompanying ASs and also with other LAs such as technology,the social sciences and mathematics for your teaching, in order for learners to use SKAVs in problem solving.

4.1 Is it possible to integrate within the NS LOs and ASs in your teaching? Provide brief information to support your answer.

4.2 Is it possible to integrate NS LOs and ASs with other LAs such as mathematics and technology in your teaching? Select either YES or NO and provide brief information to support your answer.

N.B! The DOE (2002:62-75) sets out the core knowledge and concepts of NS for the two phases, namely the intermediate phase (grades 4 to 6) and the senior phase (grades 7 to 9) in the policy document of NS for schools as well as in the *Guide for the Development of Learning Programmes* that are based on the products or system of ideas from the four themes of NS. (This part will be done after providing the educators with photo copies of pages 62 to 75 of the core knowledge and concepts of NS from the DoE (2002:62-75) for their perusal)..

5.1 What are your perceptions of the core knowledge and concepts of NS in your phase in the senior phase?

5.2 Is it possible to use the three LOs and accompanying ASs of NS in your teaching based on the core knowledge and concepts of NS?

5.3 Are the core knowledge and concepts of NS based on the material world or what you can see or do? State your views briefly and give practical examples based on a single theme/strand of NS in your grade?

5.4. Do you think the core knowledge and concepts of NS will develop an interest in learners studying NS related subject/careers in life? Answer briefly and give practical examples.

LESSON PLAN OBSERVATION NS IN GRADE 9

TYPE OF SCHOOL: TICK IS USED FOR THE TYPE OF SCHOOL

| | | | |
|----------------------|--|---------------------------|--|
| PUBLIC SCHOOL | | INDEPENDENT SCHOOL | |
|----------------------|--|---------------------------|--|

A. BACKGROUND INFORMATION FOR THE LESSON PLAN.

The DoE (2003:12) defines a lesson plan as follows, "A lesson plan is assumed to be a complete and coherent series of teaching, learning and assessment activities."

N.B! The lesson plan must be completed with either YES or NO for each item in line with the prerequisites of a formal and practical lesson plan.

| OBSERVATION ACTIVITY | YES | NO |
|---|-----|----|
| 1. Are lesson plans designed by the educator? | | |
| 2. Are lesson plans done by supplies (Like LTSM supplies or photocopied from LTSM)? | | |
| 3. Is the LA mentioned in the lesson plan? | | |
| 4. Is the duration of the lesson indicated? | | |
| 5. Is the theme/strand indicated in the lesson plans? | | |
| 6. Are the learning outcomes (LOs) of NS indicated? | | |
| 7. Are the assessment standards (ASs) of NS indicated? | | |
| 8. NS ASs give clarity on the level on how the LOs are to be achieved based on the topic. | | |
| 9. Are the assessment activities based on the ASs of NS? | | |

| | | |
|---|--|--|
| 10. Is integration indicated within the NS LOs and their accompanying ASs? | | |
| 11. Is integration indicated explicitly within NS (based on the LOs and ASs of NS)? | | |
| 12. Is there a description of the integration across the LAs LOs and ASs explicitly mentions that shows that enhance topic in planning? | | |
| 13. Are core knowledge and concepts of NS mentioned? | | |
| 14. Are the activities based on the core knowledge and concepts of NS as mentioned for Senior phase? | | |
| 15. The 70% of the core knowledge and concepts of NS shown in the lesson plan/s. | | |
| 16. Is there 30% of the immediate of learner's environment or what learners can apply the topic to their lives? | | |